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For Sale Everywhere by Newsdealers. ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

New 28-Inch Upright Drill.

This is a tool recently brought out by Currier & Snyder, Worcester, Mass., and designed for a general range of work, where strength and ease and quickness of handling are essential. It is provided with automatic feed and means of quick adjustment in all particulars.

The cone pulleys are large, and placed as far apart as possible, to give good length of belt.

Spindle and head are balanced through one chain, and the head can almost instantly be shifted in its position on face of column.

Modern Locomotive Construction.

BY J. G. A. MEYER.

FORTY-FIFTH PAPER.

PROPORTIONS OF CROSSHEAD.

Area of Sliding Surfaces.—The sliding surfaces of a crosshead should not be too large, as this will make the crosshead too heavy; sliding surfaces of a crosshead should not be too small, because with small sliding surface the pressure per square inch on these surfaces will be increased to an extent which will heat the slides and cause abrasion or cutting of the slides. Now it must be apparent that before we can determine the dimensions of the sliding surfaces we must know the pressure per square inch on these surfaces, which will give the best practical results. Knowing this pressure, and also the total pressure of the crosshead against the slides, which must be provided for, the calculations for obtaining the dimension of the sliding surfaces or the length and breadth of the gibs will be an easy matter.

According to the dimensions of crossheads in different classes of locomotives made by various builders and master mechanics, and assuming that the maximum steam pressure in the cylinders is 120 pounds per square inch, the writer finds that 50 pounds per square inch of sliding surface is a good average; in a few cases the pressure per square inch was somewhat less than 50 pounds, and in a number of crossheads 75 pounds per square inch was reached. In the writer's opinion 50 pounds pressure per square inch will give very good results, and may be adopted for determining the dimensions of the sliding surface or the gibs of a crosshead which is to be designed.

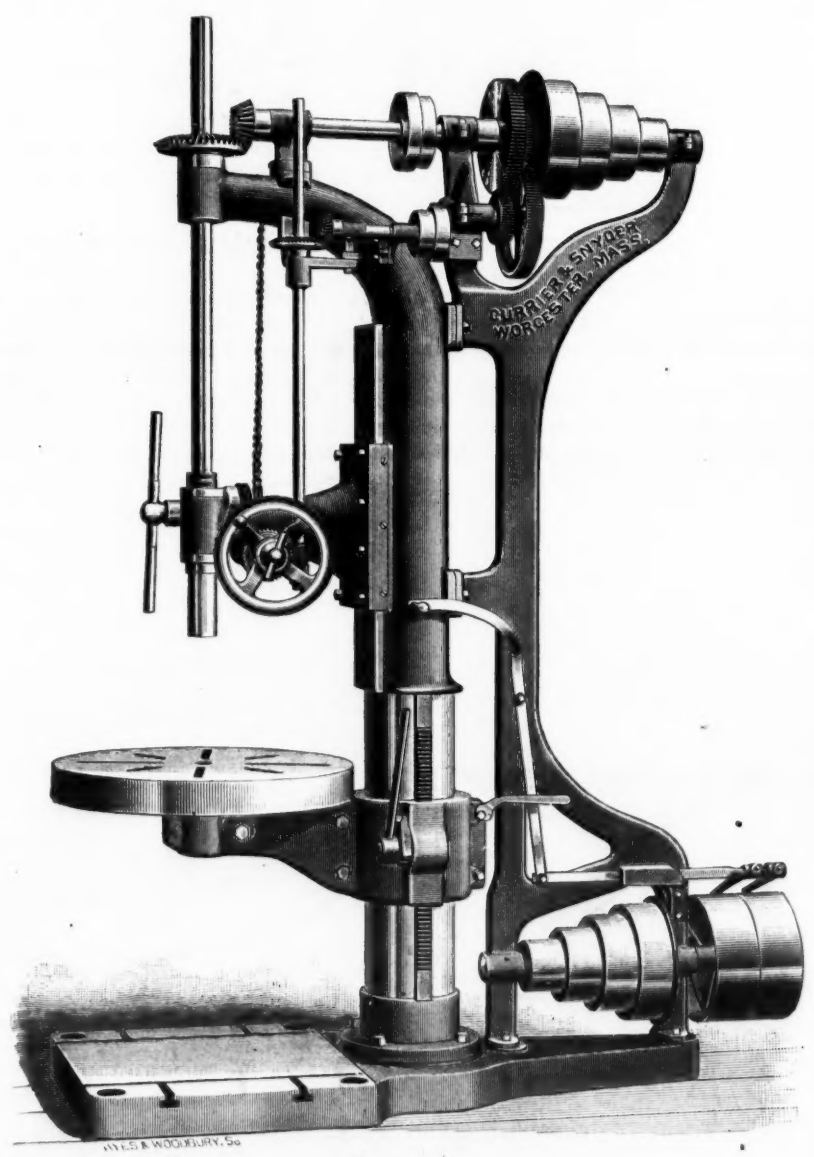
In the following we shall adopt 50 pounds per square inch as the standard. The total pressure of the crosshead against the slides is obtained by one of the Rules 15, 16 or 17 given in the forty fourth paper, August 6th. Before we can find the length and breadth of the gib or sliding surface of a crosshead we must determine the area of this surface or gib:

TO FIND THE AREA IN SQUARE INCHES OF THE GIB OR SLIDING SURFACE OF A CROSSHEAD.

Rule 19.—Divide the total pressure of the crosshead against the slides by 50; the quotient will be the area in square inches of the gib or sliding surface.

Ex. 46.—The cylinders in a locomotive are 17 inches in diameter; stroke, 24 inches; steam pressure, 120 pounds per square inch; length of connecting rod, 7 feet. It is required to find the area in square inches of the gib in the crosshead.

The area of a piston 17 inches in diameter is 226.98 square inches; the total pressure on the piston will be equal to $226.98 \times 120 = 27237.6$ pounds. According to Rule 17, the total pressure of the crosshead against the slides will be equal to $27237.6 \times \frac{1}{7} = 3891$ pounds. And lastly, according to Rule 19, we have $\frac{3891}{50} = 77.8$ area in square inches of the gib, or sliding surface of the crosshead. The dimensions of crosshead given in Fig. 240 are those of crossheads in actual use, and



TWENTY-EIGHT INCH UPRIGHT DRILL.

giving good satisfaction. In this crosshead we find the area of the sliding surface to be equal to $(3''+3'')\times 14''=84$ square inches. According to our rule, it should have 77.8 square inches. Here, then, is a difference of 6.2 square inches, which may seem to be too great; but when we consider that the width of these slides, which is $\frac{1}{8}$ of an inch greater than usually adopted in this class of engines with the same length of crosshead, and when we remember that this size of sliding surface is sometimes used in locomotives having cylinders 18 inches in diameter, we may conclude that the area found according to our rule will give satisfactory results.

Assuming that in all locomotives the maximum steam pressure in the cylinder is 120 pounds per square inch, and the ratio of the length of crank to length of the connecting rod is as 1 to 7, and that the pressure per square inch of the crosshead sliding surface must be 50 pounds, we may find the area of the sliding surface by the following simple rule:

Rule 20.—Multiply the area of the piston by thed ecimal .34, the product will be the area in square inches of the sliding surface or of gib.

This rule will give results approximately correct, that is, sufficiently correct for all ordinary locomotive practice.

Ex. 47.—What must be the area of the sliding surface of a crosshead for a locomotive having cylinders 20 inches in diameter?

The area of a 20 inch piston is 314.16 square inches, hence $314.16 \times .34 = 106.81 \times$ square inches, which is the area of the sliding surface of the crosshead. Comparing this area with that of the crosshead shown in Fig. 244, we find the area obtained by calculation to be slightly in excess of that in the illustration.

TO FIND THE LENGTH AND BREADTH OF THE GIB OR SLIDING SURFACE WHEN ITS AREA IS KNOWN.

Examining the illustrations of the crossheads, we find that the length of the gib or sliding surface is very nearly equal to five times the breadth; in some it is more, in others a little less; let us adopt the ratio of 1 to 5 as the correct proportion of the breadth to the length of these surfaces. Now, when we know the area of the gib and the ratio of its length to breadth the dimensions of the latter are easily obtained by the following rule.

Rule 21.—Divide the area of the surface by 5, and extract the square root of the product, the answer will be the breadth in inches; this breadth multiplied by 5 will give the length.

Ex. 48.—The area of a gib or sliding surface is 45 square inches; it is required to find the length and breadth of the gib.

$45 + 5 = 9$, and the square root of 9 or $\sqrt{9} = 3$ inches. 3 inches is the breadth, and $3 \times 5 = 15$ inches, is the length of the gib.

Ex. 49.—What should be the length and breadth of a gib for a crosshead with two slides in a locomotive having cylinders 18 inches in diameter?

The area of a piston 18 inches in diameter is 254.47 square inches.

The area of the gib or sliding surface, according to Rule 20, must be $254.47 \times .34 = 90.5198$ square inches. Then by Rule 21 we have $90.5198 \div 5 = 18.1039$ and $\sqrt{18.1039} = 4.25$ inches for the breadth of the gib; and $4.25 \times 5 = 21.25$ inches for the length of the gib.

Ex. 50.—What should be the length and breadth of a gib for a crosshead with four slides, in a locomotive having cylinders 18 inches in diameter?

In the solution of this problem it should be remembered that, when a crosshead has four slides, as shown in Figs. 234 and 237, the area of the sliding surface is the sum of the areas of two gibs, as *F* and *G* in Fig. 257, page 2; hence notice the following solution.

The total area of the sliding surface will be 254.47 square inches $\times .34 = 90.5198$ square inches, as in *Ex.* 49; but, as already stated, this sliding surface is made up of two gibs, hence the area of each gib must be $90.5198 \div 2 = 45.2599$ square inches, then $45.2599 \div 5 = 9.0519$, and $\sqrt{9.0519} = 3$ inches for the width of gib (the fraction being so small has been omitted); $3 \times 5 = 15$ inches for the length of the gib.

Thickness of Gibs.—Gibs are generally made from $\frac{1}{2}$ of an inch to $\frac{5}{8}$ of an inch thick.

WIDTH OF CROSSHEADS AND DIAMETER OF HUBS.

In locomotive cast-iron crossheads into which the piston rods are fitted with tapered ends, and sometimes not resting against a shoulder, as shown in Fig. 255 (see page 2), the area of the hub around the key, as shown in Fig. 256, should be sufficiently large so that the tensile stress or pull should not exceed 2,000 pounds per square inch of section. This section is of course assumed to be taken through *D E*, where the area of the hub will be smallest. Hence to find the diameter *B*, of the hub, Fig. 256, or the width *A*, Fig. 257, we may use the following empirical rule:

Rule 22.—For cast-iron crossheads, multiply the large diameter of the tapered end of piston rod, as given in Table 13, by two, the product will be the outside diameter of the hub.

When the piston rod has no shoulder fitting against the end of the hub, as shown in Fig. 255, then make the outside diameter of the hub equal to twice the diameter of the tapered end measured at *C*, that is the diameter of the hole in the face of the hub.

For wrought-iron crossheads multiply the large diameter of the tapered end, or the diameter at *C*, by 1.8, the product will be the outside diameter *B* of the hub, Fig. 256, or the width *A*, Fig. 257.

Ex. 51.—Find the diameter or the width of a locomotive cast-iron crosshead suitable for cylinders 17 inches in diameter.

According to Table 13, the large diameter of the tapered end of a piston rod for a cylinder 17 inches in diameter is $2\frac{3}{8}$ inches, hence $2\frac{3}{8} \times 2 = 5\frac{1}{4}$ inches for the outside diameter of hub.

Ex. 52.—What must be the width of a wrought-iron crosshead, suitable for cylinders 20 inches in diameter? According to Table 13, the large diameter of the tapered end of the piston rod is 3 inches; hence $3 \times 1.8 = 5.4$ inches, which is the width of the crosshead.

Sometimes this width must be somewhat changed to suit the width of the slides, or the length of the crosshead pin.

DIMENSIONS OF SLIDES.

Length of Slides.—The slides should be made as short as possible; that is, they should not be made any longer than is required for the length of sliding surfaces, stroke and clearances between the slide blocks and crosshead. In practice, half of an inch for clearance at each end of the crosshead is generally considered to be the least amount that should be allowed. Consequently, if in Fig. 234 the stroke is 24 inches, the length of the sliding surfaces (which in this case is equal to the length of the gibs) is equal to $15\frac{3}{4}$ inches, and the clearance at each end is equal to half of an inch, then the shortest distance between the slide blocks is equal to $24'' + 15\frac{3}{4}'' + \frac{1}{2}'' + \frac{1}{2}'' = 40\frac{3}{4}$ inches. If to this distance is added the necessary amount of length of slide for bolting it to the slide blocks, then the shortest length of slides will have been obtained.

Sometimes the general design of a locomotive, generally the position of the driving wheels, will compel us to make the length of the slides greater than that determined by the foregoing figures.

Breadth of Slides.—For the breadth of the slides we must determine the breadth of gib or sliding surfaces of the crosshead, according to rules already given.

Thickness of Slides.—In order to determine the thickness of a slide we must consider it to be a beam, firmly fastened at the ends, and loaded in the middle. The rule for finding the thickness of a beam, when all its other dimensions and load are known, is as follows: Multiply the length of beam in feet by the load, and divide this product by the breadth in inches multiplied by a constant number. The square root of the quotient will be the thickness in inches. The constant number alluded to is a number determined by experiment, and is not the same for different kinds of material. From these remarks we would infer, and correctly, too, that a different constant should be used for steel than is used for iron beams. But in locomotive practice it is customary to use the same constant for wrought-iron and steel slides, and this practice we shall follow in these papers. This constant number used in calculating the strength of slides is 1,200.

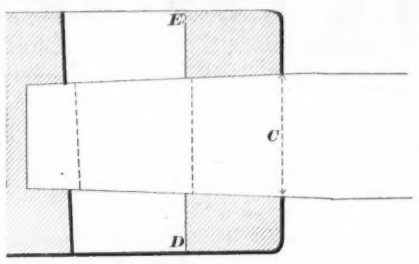


Fig. 255

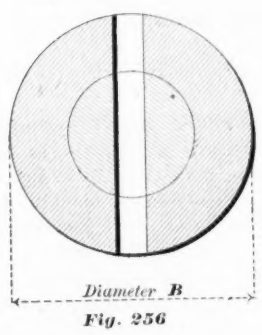


Fig. 256

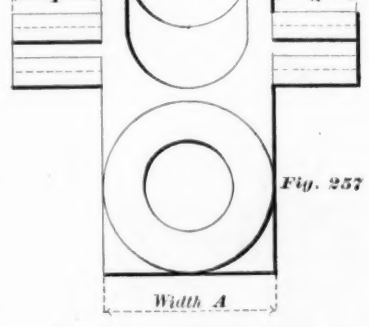


Fig. 257

LOCOMOTIVE CONSTRUCTION.

In these calculations we shall for the sake of simplicity, call the distance between the slide blocks the "length of the slides." Hence for finding the thickness of a wrought-iron or steel slide we have the following rule:

Rule 23.—Multiply the length of the slide in feet by the load in pounds; divide this product by the breadth in inches, multiplied by the constant number 1200; extract the root of the quotient, then the answer increased by an amount deemed necessary for re-planing and wear will be the thickness of the slide in inches.

Ex. 52.—Find the thickness of the slides (two slides being used for one crosshead) for a locomotive having cylinders 20 inches in diameter, 24 inches stroke, length of slides 4 feet, breadth of slides $4\frac{3}{4}$ inches, length of connecting rod 7 feet, steam pressure in cylinders 120 pounds per square inch.

In the first place we must find the load which these slides will have to support. The load is equal to the greatest pressure of the crosshead against the slide, and consequently can be found by Rule 17. Now, we have for the total steam pressure on the piston 314.16 square inches area × 120 pounds = 37699.2 pounds, and according to Rule 17 we have $37699.2 \times \frac{1}{7} = 5385.6$ pounds of pressure of crosshead against the slides, which is now considered to be the load that one slide will have to support.

Now, to find the thickness we have according to Rule 23

$$\frac{5,385.6 \times 4}{4\ 75 \times 1,200} = 3.77;$$ and the square root of 3.77, or $\sqrt{3.77} = 1.9$, say 2 inches; adding to this $\frac{1}{4}$ of an inch for trueing up when that becomes necessary through wear, we have $2\frac{1}{4}$ inches for the thickness of slide.

Ex. 53.—Find the thickness of the slides (four slides being used for one crosshead) for a locomotive having cylinders 17 inches in diameter, 24 inches stroke, length of slides 3 feet $4\frac{1}{2}$ inches (=3.375 feet) breadth of slide 3 inches, length of connecting rod 7 feet, and steam pressure in cylinder 120 pounds per square inch.

Area of piston = 226.98, hence 226.98 square inches × 120 = 27237.6 pounds total steam pressure on the piston, and $27237.6 \times \frac{1}{7} = 3891.08$ pounds, which is the load two slides touching the gibs *F* and *G*, Fig. 257, will have to support, consequently one slide will have to support

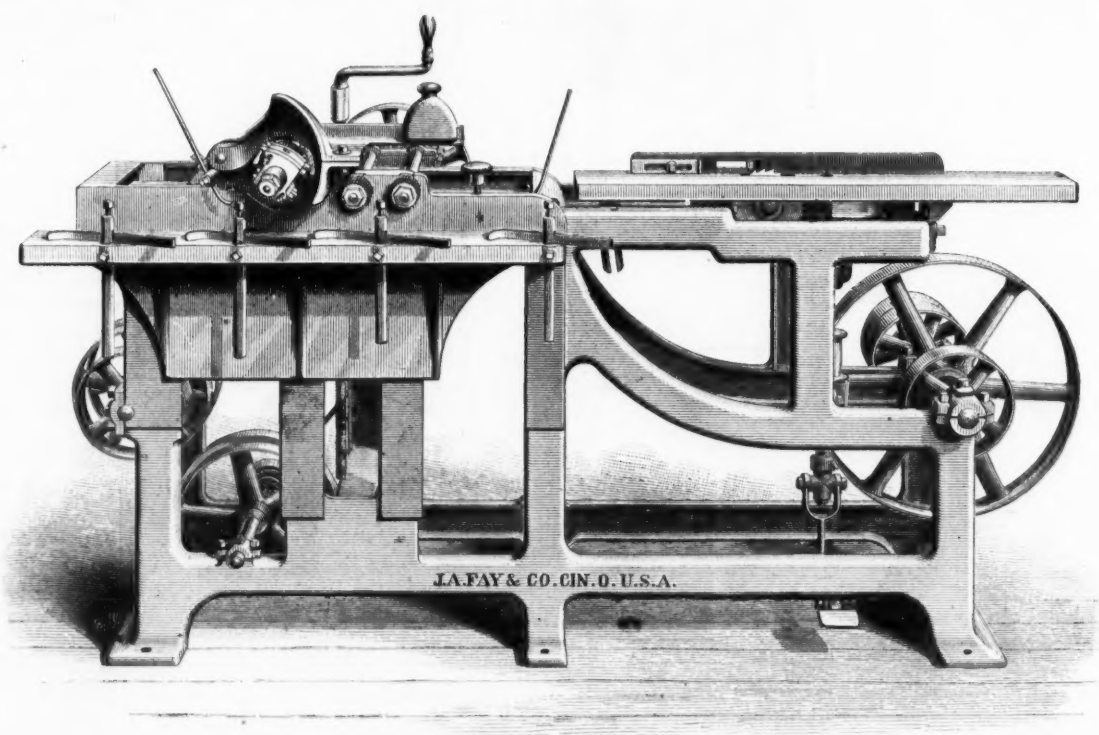
$$\frac{3891.08}{2} = 1945.54 \text{ pounds,}$$

$$\text{and } \frac{1945.54 \times 3.375}{3 \times 1200} = 1.80,$$

the square root of 1.80, or $\sqrt{1.80} = 1.34$, say $1\frac{3}{8}$ inches, add to this $\frac{1}{4}$ of an inch for trueing up we have $1\frac{5}{8}$ inches for the thickness of sides.

Improved Sash-Sticking Machine.

This machine is designed to do the work which formerly required two machines and two men, and is a very efficient machine for sticking sash stiles, and plowing and boring for the sash cord at the same time. The cutter spindles are of best steel, run in long self-oiling bearings which are lined with the best lining metal.



SASH-STICKING MACHINE.

The plowing and boring attachment consists of a supplemental table with vertical boring spindle and horizontal grooving head and spindle, placed at the feeding end of the machine. The table has a vertical adjustment, and is fitted with adjustable stops for gauging the length of the groove and position of the hole for the knot in the end of the cord. The stile is first moved along the table over the grooving saw, cutting the groove to the proper length, and then the boring is accomplished by means of a foot treadle, raising the boring bit into the stile to the proper depth. This work being performed, the stile is passed under the feed roll and horizontal cutter head and properly dressed. As the plowing and boring of one stile is done while another is passing through the sticking machine there is really no expense whatever attending the plowing and boring. A boy can operate the machine with ease.

The feed roll is large in diameter, and strongly geared, producing a positive feed.

A compound bonnet and pressure bar is placed on the machine, which can be swung entirely out of the way for ready access to the sticking head for purposes of adjustment. The machine can be used for sticking door rails, blinds, etc., by having suitable heads and cutters. Full set of wrenches, springs, etc., go with each machine.

The manufacturers are J. A. Fay & Co., Cincinnati, Ohio.

The Comparative Value of Steam and Hot Water for Transmitting Heat and Power.

BY CHAS. E. EMERY, NEW YORK CITY.

FROM A PAPER PRESENTED AT THE WASHINGTON MEETING OF THE MECHANICAL ENGINEERS.

If steam and hot water of 400 degrees temperature be respectively used for some heating purpose, such as cooking, requiring nearly that temperature, the steam will give up its latent heat and be converted into a small quantity of water at the final temperature, while hot water can only give up its sensible heat represented practically by the difference between its original and final temperature. If the fall of temperature be from 400 to 399 degrees, the water would impart substantially one thermal unit for each pound of water circulated over the surface, while the steam would impart over 800 thermal units for each pound of water condensed. If a difference of 2 degrees were allowed, the water would impart substantially two thermal units for each pound of water circulated, whereas the heat supplied by the condensation of one pound of steam with same limits of temperature would be but slightly reduced, though the relative quantity of water required to be circulated to equal the results obtained with one pound of steam would be reduced one-half. By allowing a still greater reduction of temperature the water would appear at less disadvantage. For instance, with a difference of temperature of about 11.15 degrees the water would impart $11\frac{1}{2}$ thermal units for each pound of water circulated and the steam 842 thermal units for each pound condensed.* This is doubtless a greater reduction of temperature than could be allowed for cooking, and yet it would require (842.04 ÷ 11.52 =) 72.71 times as much water circulated to do the same work as would be required if steam were used. In this case then 72.71 pounds of water would necessarily be heated at the station, pumped to the point where the heat was required and then be forced back again to the station at a lower pressure and pumped into the boiler to be reheated, for each

* (A) Temperature due to 235 lbs. gauge or 200 lbs. absolute pressure, 400.89; temperature due to 205 lbs. gauge or 220 lbs. absolute, 389.74° – difference 11.15°. Total heat above 32° in the two cases respectively, 373.75 and 362 17—difference 11.5 thermal or heat units. Total heat steam of 235 lbs. gauge pressure, 1204.21 heat units. Subtract 362. 17 heat units due to final temperature, gives 843. 04 heat units, available from condensation of steam between limits of temperature stated.

pound of water evaporated if steam were used as the medium of transmission. The steam would be transmitted by causing a slight difference of pressure from the heating station to the point where it was used, and its surplus pressure would return the water of condensation back to the station, where one pound would require to be pumped in the boiler for each 72.71 pounds by the water system.

As the temperature at which the heat is to be applied is reduced, the preponderance against the water system somewhat diminishes. For instance, if steam at 70 pounds pressure be required to operate engines, it may be obtained by directly expanding down the steam of 235 pounds pressure, which would result in a beneficial superheating of 25.87 thermal units per pound of steam thus expanded. If, however, the steam were supplied from hot water at 400.89 degrees temperature, corresponding to the pressure of 235 pounds, only 10.2 parts in 100 would, on reducing the pressure to 70 pounds, flash into steam at that pressure, so in that case 10.2 pounds of water would necessarily be heated at the central station, transmitted to the point where steam is required, and if high pressure engines were used, 9.1 pounds would necessarily be transmitted back again, and finally 10.1 pounds pumped in the boiler for each pound weight of steam used, instead of the one pound which would be required to be evaporated at the central station in the case of the steam plant.*

For heating purposes the temperature could under favorable circumstances be reduced to 228 degrees in the coils, corresponding to a pressure of five pounds, in which case, without repeating the operations above described, there would require to be circulated from the heating station to the point of supply and back to such station, 5.69 pounds of water for each pound of steam utilized at the point of supply, or for the heat which would be imparted at the temperature corresponding to such pressure, for each pound of steam which in a steam system would be evaporated and sent direct from the station.†

The above statements may be easily verified from the figures given in the foot notes and the great resistances found in pumping water through pipes at high velocities being well known, there would seem to be no reason why any one should think of using water rather than steam for the purposes above referred to. The subject has, however, been agitated for a number of years. Little plants to show what could be done with water heated to a high temperature have been built from time to time, but apparently did not command the capital necessary to start the business on a large scale. Another revival has recently been attempted, however, based chiefly on the favorable report of an unusually well informed engineer of experience and acknowledged ability, to whom it is a pleasure to say the writer is personally indebted for many valuable suggestions as to proper courses of study at an earlier period of life. Mr. Isherwood, in forming his opinions has evidently, however, failed to consider some of the most important elements of the problem, and occasion is thereby made for an abstract discussion on the merits of steam and hot water, so far as possible, without reference to the merits of a particular system and the details of the same.

It has been stated in the public press, quoting from the report, that a cubic foot of water at 400 degrees temperature contains $34\frac{2}{3}$ times as much heat as is contained in a cubic foot of steam at the same temperature, and it is therefore concluded that "the areas of the pipes will be in this proportion, making their diameters in the proportion of 1 for the water and ($\sqrt{34\frac{2}{3}}$ =) 5.89 for the steam." Also that "the thickness of the material of the pipes for equal strength would have to be about six times greater for the larger steam pipe than for the smaller water pipe even if both were lap-welded." On the supposition that larger steam pipes would be necessary, comparisons were presented of the "greater bulk," "enormously greater cost," "extra loss of heat by conduction and radiation" due to the larger pipes, with some further remarks about the difficulty of getting rid of the water of condensation in steam pipes, difficulties of management, etc., not at all warranted by the state of the art in relation to steam plants. Evidently the error behind these statements is to be found in the assumption that because a given quantity of water of the temperature assumed, contains $34\frac{2}{3}$ times as much heat as that of an equal volume of steam, therefore the steam pipe must be proportionably larger to that extent. It ignores entirely well-known laws of hydraulics which teach that a fluid of much less density than another will, with the same difference of pressure, flow at a much higher velocity. The weight of a fluid transmitted through pipes with comparatively small differences of pressure at opposite ends, is proportioned to the square root of the fifth power of the diameter of the pipe, into the square root of the pressure gradient (represented by the difference of pressure between the two points divided by the length) into the square root of the weight per unit of volume of the fluid, for instance, the weight per cubic foot, called by Weisbach the "heaviness," and herein designated the "specific weight." Therefore, for the same loss of pressure in the same distance and the same size of pipe, the relative weights of water transmitted would vary as the square roots of the specific weights. The weight of a cubic foot of water at 400 degrees is approximately 53 pounds, and a cubic foot of steam at the pressure of 235 pounds, due to such temperature, is 0.5478 pounds. The relative weights of the steam and water are therefore as 1 to 96.36. The weights transmitted under like conditions as above referred to, would therefore be as the square roots of these numbers, or as 1 to 9.816. Therefore, if the steam and water be compared on the basis of use for heating buildings exclusively, which, as has been shown, is most advantageous to the water system, there would, as has been stated, be required a circulation of 5.694 times as many pounds of hot water as of steam; but 9.816 pounds of water would, under like conditions, be circulated to 1 of steam. The relative capacities of the pipes required to convey the steam and water under like conditions would then be, for the steam, 1, and for the water, the increased weight required, viz., 5.694, divided by the increased weight conveyed, viz., 9.816, or as 1 to 0.5796, or as 1.7253 to 1. But the carrying capacities of the pipes are not as the areas or the squares of the diameters, but, on account of the friction element, as the square root of the fifth power of the diameters, on which basis, under this most favorable condition for the water pipe, the diameter of the steam pipe would require to be but 24.38 per cent. in excess of that of the water pipe. This does not, however, represent the relative cost of the system. For heat taken the same distance, the return pipe of the water system must be as large as the direct pipe; whereas that of the steam system, which has to do but about one-sixth of the work, could, on merely theoretical conditions, have a carrying capacity that much smaller. For practical reasons which, as will be shown hereafter, will have greater force with the water system, this pipe is made somewhat larger, or, on the average, about one-half of the diameter of the steam pipe. On the basis that the costs are proportioned to the lengths and diameters, which is not far from correct when the two pipes are laid together in the same trench, the cost of the steam pipe of 1.2438 diameter should be increased one-half, to allow for the return pipe, making in the case of the steam system 1.8657, compared with 2, as the cost of the full-size double pipes of the water system, which numbers are as 1 to 1.072; that is, even under the most favorable conditions for the water pipes, they would cost at least 7 per cent. more than the steam pipe system; and even this result is obtained by favoring the water system in the calculations, for the reason that the water has to be pumped double the distance that the steam is conveyed, and therefore requires double the difference of the pressure. However, as this pressure is produced with a pump, for simplicity, the comparison has been allowed to stand as above.

If the water pipes were designed to furnish power at a distance, by generating steam to be used at 70 pounds pressure, it would be necessary, as stated, to circulate 10.2 times as much water as would require to be evaporated for steam used directly, when, on the same basis previously discussed, the water pipes would require to have 3.9 per cent. greater carrying capacity under like conditions than the steam pipe; that is, would require to be of 1.55 per cent. greater diameter, when the cost of both the direct and return water pipes would be 35.4 per cent. greater than that of the steam pipe and its smaller return pipe.

If, however, the water plant were designed to furnish water for cooking purposes, and the temperature were maintained in the stoves at 400 degrees, by circulating, as claimed, water of only 400 degrees, there would be required the circulation of an infinite quantity of water to fulfill this condition. If, however, the temperature in the stoves was allowed to fall one degree below that of the water, there would require to be circulated, as first stated, something over eight hundred times as much water as would be required to be evaporated and conveyed if the work were done by steam. Without stopping to calculate the size of the enormous pipe required on this basis, we may assume, as before, that in practical work a loss of, say, 11.15 degrees would be permitted. On this basis, as stated, the water required to be circulated would be 72.21 times the weight of steam required to do the work, so the water pipe would necessarily have 7.407 times the carrying capacity of the steam pipe, or 2.228 times the diameter; and the cost of the two systems of piping on the basis above explained would be as 1 for the steam to 2.97 for the water. We thus see that, in doing exclusively the work for which these high-pressures are principally to be carried, to wit, cooking, instead of the steam pipes requiring to be $46\frac{2}{3}$ times the area, or 5.8 times the diameter of the water pipe, as claimed, the water pipes must have $7\frac{1}{3}$ times the carrying capacity, be of about $2\frac{1}{4}$ times the diameter, and about 3 times the cost of the steam pipes. The relative cost of the pipes by no means represents the cost of operating the two systems. The water system would always be at a disadvantage in this respect, on account of the high cost of pumping.

It should be stated that it is proposed to use steam for power at only 20 pounds pressure, but it is unnecessary to say that this would involve a very extravagant use of steam, and the size of the pipes would only take an intermediate position between those given for heating and power respectively. It may also be claimed that the fall of pressure available to transmit steam is limited, whereas the pressure available by pumping to force the water is comparatively unlimited. This will not sustain investigation. With an initial steam pressure of 80 pounds a loss of pressure of but ten pounds will give, in a steam pipe 12 inches in diameter and one-half mile long, a velocity of fully 80 feet per second, so that there will be readily transmitted, through such pipe, nearly 1,700 horse-power of 30 pounds of feed water per hour for that entire distance. The most unfavorable conditions for the transmission of steam are when used for cooking where a high temperature is to be maintained; but even in this case, unless the assumption be made that the water will maintain the ovens at 400 degrees with steam at 400 degrees temperature, which, as has been stated, will require an infinite quantity of water circulated, there must be some loss of temperature, and as soon as it is permitted to drop, so that instead of fabulous quantities only 72 times as many pounds of water is required to be circulated as of steam, the loss of temperature of about 11 degrees entails a loss of pressure of 30 pounds, and but a portion of this difference of pressure will circulate the steam as fast as would be safe for the permanence of the pipes. With water the velocity would need to be kept down in the inverse proportion of its density compared with that of steam, for a similar reason. If the necessary loss of temperature for cooking be made up by increasing the temperature of the water, this would also, in a much greater ratio, increase the pressure of the steam and still keep it at an advantage.

An average presentation of this branch of the subject may be had by examining the pressure available when the hot water and steam are used to furnish steam for power. In the case of the hot water, in order to evaporate about ten per cent. of its volume into steam, the reduction in temperature will be that due to a fall in pressure of 165 pounds, or from 235 down to 70 pounds. In a steam system this entire difference of pressure may be used as the energy which transports the steam to the point where it is used, and as the pumping pressure on the principles above expressed must be double this, the circulating pump would require to work against a pressure of 330 pounds to compete with steam, and 10.2 times as much water must be pumped with the water plant as would be required by the steam plant; also the water for the water plant must be pumped twice: once at the high pressure of 330 pounds to circulate it in the pipes, and again at 235 pounds to pump it into the boiler; whereas, with the steam plant one-tenth of the quantity of water would be pumped, and but once, viz., into the boiler. It may, however, be claimed that the steam plant must be charged with the power required to return the water of condensation. The water is returned in practice by the pressure in the heating systems or by steam operating pumps, or pump traps which exhaust into the heating systems, so that no heat is wasted, and the losses are too inconsiderable to mention in comparison with the handicaps of the water system.

The hot water circulated has been called "superheated water," because it is hotter than 212°, but, of course, water cannot be superheated in the scientific sense that its temperature exceeds that due to its pressure. Steam may be superheated and must always have as high a temperature as that due to its pressure. Water cannot be superheated, but may, of course, have a pressure greater than is due to its temperature; in other words, be *sub*-heated, which is the condition that the so-called superheated water would be in when maintained at constant pressure the moment it imparted any heat to another object.

Reference must finally be had to one point, which has been made to appear very important on paper. The following quotation may be made:

"The fuel cost of the power developed by the steam engines employed in [a hot water] system for circulating the superheated water in the hot water pipe, for pumping the used water from the return pipe into the boiler, for driving the blowers, if a mechanical supply of air is needed for the combustion of the coal, and for hoisting coal and its refuse, will, owing to the peculiarity of the system, be not over one-twelfth of the similar cost per horse-power

* (B) Total heat steam of 70 lbs. gauge or 85 absolute pressure, 1178.34 heat units, which, subtracted from 1204.21 heat units due to 235 lbs., foot-note (A), shows 25.87 heat units for superheating. Temperature due to 70 lbs. gauge 316.08 corresponding to 286.26 heat units above 32°, which subtracted from 373.75 heat units due to 235 lbs. (A) leaves 87.49 heat units available for making steam with water and subtracting same from 1178.34 heat units, total heat due to 70 lbs. gives 892.08 heat units required for steam of 70 lbs. Hence, there will be required 892.08 ÷ 87.49 = 10.2 pounds of water circulated per pound of water evaporated into steam of 70 lbs. pressure.

† (C) Temperature due to 5 lbs. 227.96° equivalent to 196.66 heat units above 32, which latter subtracted from 373.75 heat units in water due to 235 lbs. pressure, gives 177.09 heat units per pound of water and subtracted from 1204.21, total heat due to 235 lbs. pressure gives 1007.56 heat units available from steam between same limits, so that there will be required (1204.21 ÷ 177.09 =)5.694 times as much water circulated as steam.

developed by the most economical steam engines employed in other work. In fact, the only coal required to work the circulating, pumping, blowing and hoisting steam engines, is what furnishes the heat actually transformed into work, according to the thermodynamical theory, and to supply the loss of heat by conduction and radiation from the external surfaces of these engines. The cooled water from the return pipe will be in such excessive quantity compared with the feed water required for generating the steam used in the engines, that it will be enormously more than sufficient to condense all the steam worked through the engines, the condensed steam and the water condensing it will be wholly pumped back into the boiler, and there will be no rejected heat, as in the case of other steam engines, which rejected heat averages about eleven-twelfths of the total heat of the vaporization of water. If the cost of the indicated horse-power in the best engines be taken at about 2 2-5 pounds of ordinary coal per hour, that cost, with the engines of [a hot-water] system, will be only one-tenth of a pound of coal per hour. The steam taken from the boilers at the temperature of 400 degrees Fahrenheit (pressure 250 pounds per square inch above zero) for working the engines, will be condensed by the water of the return pipe at the temperature of, say, 160 degrees Fahrenheit, and both the water of condensation and the condensing water will be pumped into the boiler, so that the total quantity of water in the boiler and in the hot water pipe and in the return water pipe will always remain constant."

With all the hot water used for power purposes rejected at a temperature of 316 degrees, and that for cooking at 390 degrees or upward, how is the very large quantity of heat still remaining in the water to be reduced to the temperature of 160 degrees, as stated in the above extract? It may be said it will be used for heating water, boiling articles of food, heating buildings, and such like uses. But what can be done with it in summer when there is no heating to do, and even in winter or at any other time? In fact, how is the surplus heat in the hot water from cooking and power apparatus to be exactly that required for some other culinary operation or for heating some particular building? The slightest calculation will show that the surplus heat will be so great that it cannot in practice be reduced to the temperature stated. The low temperature of the return water could only be secured in individual instances in buildings provided with specially large heating coils arranged to receive the water as it was about to escape to the street. Houses and public buildings already provided with heating apparatus would necessarily have connections made to the apparatus in place, and the heat would be rejected at the temperature of the steam used for heating, say at the temperature due to five pounds, as has been provided for in the previous calculation. In no case, as has been intimated, could it be assured that the surplus heat from the cooking apparatus would not exceed that required for other culinary operations and heating the house. In seasons when no heat was required the only economical way to dispose of the hot water at 390 degrees rejected from the cooking apparatus would be to pump it back to the station at that temperature and at the pressure due thereto. The result would only be worse were it allowed to expand down to atmospheric pressure, for then a large portion would fly into steam and the return pipes be filled with a mixture of steam and water. If the hot water were used to generate steam for power the surplus heat would be so great, that it would be impracticable to dispose of it in the same or adjacent buildings even during the heating season. Few factories can use all the exhaust steam from their engines, whereas with the water system there would be about five times as much heat in the rejected water as would be used in the engine. If part of the latter be used for heating, the heat in the exhaust steam must be absolutely wasted. In fact, at all times a very large quantity of hot water must be rejected at the temperature of 316 degrees due to the pressure, and as in the case of cooking, the only economical way would be to return it to the station at a pressure of 70 pounds. If it were permitted to expand down to the pressure of the atmosphere, there would be 2.89 cubic feet of steam per pound of water circulated, or 29.4 cubic feet of steam at atmospheric pressure in the returns for each pound of water evaporated into steam for use in the engines, and the volume of steam in the return pipes would be about 60 times as large as that of the water contained in the same. Of course, in a small plant for exhibition purposes radiators may be arranged to keep down the temperature rejected from cooking and power systems, but a slight study of the problem will, as above indicated, show that the demands for different purposes cannot be adjusted, even in winter, so as to prevent the rejection of a great deal of heat, and that in summer the heat in the water can practically only be utilized through a small range of the higher temperatures, and much the greater part of the heat must be rejected, though it may be returned to the station at great cost and be saved if practical means are found for the purpose.

The writer has thus far discussed the subject in the abstract without comparison with other work. At this point it may be of interest to state that precisely the feed water apparatus described above has been used from the first in the plant of the New York Steam Company designed by the writer, and that we are barely able to condense the steam which comes back in the returns when half the feed water is supplied directly from the Croton mains to make up the loss due to the escape steam from high-pressure engines supplied on the lines. At times a portion of the steam from the pumping engines can also be condensed in the tank, but at others a portion of this escapes. It is utterly hopeless to do better or even as well with a very much larger proportion of hot water supplied from the returns.

If the present proposed system, to return the water at high pressure, be changed, then without helping the feed-water question, all the old complications of the former developments of the system will be necessary in every house, and under some circumstances boilers would necessarily be used on the premises arranged to be heated by hot water instead of fuel. On the other hand, if steam be used merely the full range of temperature is available for every operation, and the heat rejected due to the smaller quantity of water required be readily returned to the station by the surplus pressure in the pipes.

It will naturally be asked what the probable cost of pumping the hot water will be. This requires the assumption of a certain set of conditions. Previous discussion has been based on allowing the hot water a difference of pressure at the two ends of the line of twice that allowed to the steam between the station and the point of use. On this basis, with a comparatively low pumping pressure, say a difference of twenty pounds between the extremes of the line, the net power required for pumping would be somewhat more than one per cent. for each volume of water pumped compared with that required to be pumped in the boiler for a steam system. Reckoning the efficiency of steam pumps at 50 per cent. on the basis of one horse-power for the heat required to evaporate 30 pounds of water from 70 pounds pressure per horse-power, there would be required for circulating water for heating fully 11.4 per cent. of the power transmitted through the pipes; for power there would be required fully 20.4 per cent., and for cooking fully 145.4 per cent. Higher pumping pressures would of course entail higher losses. For the steam plant, on the contrary, there would be required on the same basis for pumping the water in the boiler, a little less than 2 per cent. of the power transmitted, and this cost would be independent of the loss of pressure in transmission. The water in the returns would be forced back, as has been stated, by surplus pressure. It will be seen, therefore, that the water plant will not only be more expensive to construct originally, as well as more difficult to operate, but that the actual cost of the operation would be greater in the proportions stated, independent of many other considerations which cannot here be discussed, which would make the cost still greater on account of the indirect method of doing the work.

The resistance to explosion of the steam and of the water pipes could be made the same originally by increasing the thickness of the water pipes proportionally to their increased diameters; but if high capacities were attempted by pumping water at very high velocities the pipes would be rapidly scoured out so as in time to become dangerously thin. In case of a break in the steam pipe the steam dissipates at once and is not dangerous. The writer has known a case where, through carelessness of workmen, a man was struck full in the body at a distance of only a few feet by a jet of steam two inches in diameter issuing from a pipe at 80 pounds pressure, but no injury to his person whatever resulted. Evidently, however, a single quart of hot water, projected in the same way, would have caused fearful scalds, and anything like the same quantity of water as of steam would have caused a lingering death. Hot water is also very destructive when the pressure is suddenly released, and the flying particles would scald persons and do other injuries, even when projected long distances.

There is, however, a separate question as to the relative advantage of transmitting steam, at the high pressure of 235 pounds referred to above, compared with a transmission at a pressure of 80 or 90 pounds corresponding to that ordinarily used in practice. Evidently the lower pressure will supply all the steam which is required for heat and power purposes quite as well as if generated at the very high pressure. The only possible object in increasing the pressure would be to do some kinds of cooking which cannot be done with the lower pressure, and it may be claimed to save something in the size of pipes. So far as the latter is concerned, the increased thickness must also be taken into consideration.

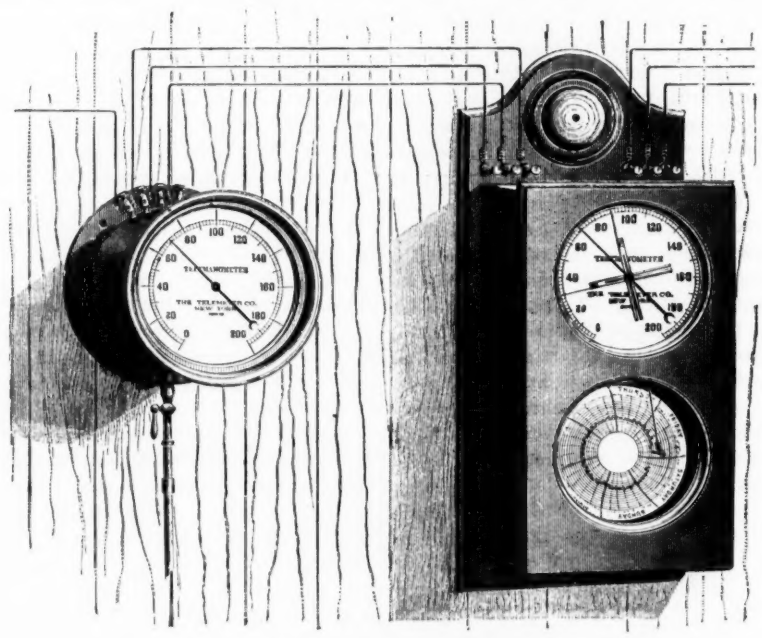


Fig. 1. The Tele-Manometer. Fig. 2.

The Tele-Manometer.

In the device which we illustrate herewith, a novel and useful application of electricity is made. The device consists of two instruments electrically connected viz., the steam gauge proper, Fig. 1, connected to the boiler or steam pipe in any convenient manner, and the indicator and recorder, Fig. 2, usually located in the office.

The two instruments can be any distance apart, and yet the pressure at the place where the gauge is located will be accurately indicated and recorded in the office. A continuous record of the pressure is made in red ink, and an alarm bell will ring whenever the pressure rises above or falls below the limits at which the alarm hands have been set.

By locating the recorder in the office the steam pressure at any time can be seen at a glance, and the continuous record is available at all times for reference. Such a record is not only valuable in noting the economy of different pressures of steam when it is desirable to experiment in that direction, but in case of any accident to boilers it will tell the story of whether or not there was pressure higher than that allowed.

If there is trouble with regulation the management can see equally with the engineer if the fault is with the steam pressure carried, and any falling off in economy will naturally bring about examination of the record.

The instrument is said to work with unfailing accuracy up to the limit of accuracy of the best steam gauge. They are manufactured by the Telemeter Co., 44 Barclay street, New York.

Regulations for Testing Portable Engines.

We gave last week the result of tests of two small engines at the Royal Agricultural Show in England. The regulations under which these engines were tested will be of interest. They were as follows:

1. Each engine shall be measured, weighed, and described in accordance with the tabulated form sent herewith.

2. Each exhibitor shall declare the steam pressure, the revolutions per minute, and the brake horse-power, at which he wishes his engine to be tried. The brake will be driven direct from the crank-shaft by means of a short connecting shaft and universal joints. A coupling to key on to the crank-shaft of the engine will be sent to each exhibitor.

3. *Preliminary Run.*—Steam will be got up in each engine, and it will be set to work on the brake at the declared speed and power, and will be kept running until, with the regulator and governor valve full open, the speed and pressure of steam begin to decline. The time occupied in raising steam and in getting ready for the trial run, together with the revolutions made, the fuel (including 8 pounds of wood) and the stores consumed, will be noted.

4. As soon as the speed has shown a tendency to fall, the engine will be stopped; any coal remaining on the bars, and the ashes, will be raked out; one pound of wood will be served out to rekindle the fire, and a weighed supply of coal will be issued, after which the trial run will begin. The duration of each trial will be four hours, or as near thereto as can be arranged. During the trial run there will be noted, the steam pressure, the temperature, and the quantity of the feed water, and that of the water dis-

charged by pet-cocks and jacket drains, and the level of the water in the boiler before starting and shortly after starting. At the end of four hours the supply of fuel will be stopped, the unused supply will be weighed back, and the trial will be continued till, the regulator and throttle valve being full open, the speed shows a tendency to decline. The height of the water in the boiler throughout the trial must be kept as constant as possible, and at the termination should be left at the level at which it was when the trial commenced; any slight unavoidable difference will, however, be noted. To assist in observing the speed a speed indicator will be attached to each brake, and attention must be paid to keeping the engine as nearly as possible to the uniform speed of revolutions declared.

5. When the trial run is over, coal will again be served out, and the engine will be kept working under the same conditions as those which prevailed during the trial run, in order to allow of experiments for determining the temperature and the pressure of the furnace and the smoke-box being made, of the gases being collected for analysis, of indicator diagrams being taken, of the supply of air being measured, of the governor efficiency being tested, and of any other experiments or tests being made which the stewards or judges may deem to be advisable as throwing light on the particular engine under experiment, or upon the general question of steam motors.

6. The oil cans in use by each exhibitor will be emptied, and a weighed quantity of oil supplied by the exhibitor, the nature and price of which will be noted, will be served out. At the end of the run the oil remaining will be weighed back, in order that the consumption may be accurately ascertained. A similar course will be pursued with the tallow.

7. Each exhibitor is to provide a driver for his engine, and during the four hours' trial run no person other than this driver is to assist in the working of the engine.

Need of Special Tools for Making Standard Machinery.

By W. H. Hoffman.

In my late papers on cheap steam engines I stated that a 40 horse-power automatic engine, guaranteed to produce a horse-power with 3.25 lbs. of coal per hour, and perfect in its regulation, could be purchased for about $20 per horse-power. I also stated that I considered this a fair price, and I see no reason to change my opinion under the present general systems of machine shop practice in our steam engine works throughout the country. The steam engine and steam pump builders, for example, fix on a certain profit for their standard machines; and they cannot go below the safety point in prices without a general break in the market, attended with its usual troubles. Now these safety or limit lines are almost as numerous as the builders, for the systems of producing the finished work are also numerous.

The costs of materials delivered also vary; but where the builder is far removed from the metal-producing centers, his labor is usually enough cheaper to counteract the extra cost of iron, etc., so that the shop costs are not widely different where the same shop practice is followed by competent foremen. But we find that some builders are accused by their competitors of cutting prices, and competitors predict all manner of disasters in store for the wicked price cutters. Yet the latter live, and persist in keeping the country very well supplied with their wares.

When one maker sells an engine or a steam pump ten per cent. less than another, both using the same kind of stock, there must be something in the management in the business and machine departments that accounts for the continued success of the so-called "price cutter." The real truth is that, nine times in ten, the man who cuts the price ten per cent. can do so without the least fear of disaster to his business, as he has so improved the methods of manipulating the materials, and so organized his machine shop operatives, that his savings over his neighbors' methods are even more than the cut in the price, while his work is generally better in quality.

One of the worst "time-killing" machines is a planer, even when fitted with the best quick-return motion. Therefore the continuous-cutting tool should always be adopted, if possible; and the use of this tool can be made possible in hundreds of cases, if a little more thought is given to the original design of the machine to be manufactured. A spotting piece on an engine frame for fastening a guide bar can be milled with a face cutter, in one-third the time required to plane a strip. In fact, an engine frame can be so designed that no planing is required.

The cylinder, and the valve faces of many of the standard automatic high and low speed engines can be machined by continuous cutting, if the proper machine is constructed to do this work, and the writer has often wondered why some of our tool makers have not produced more special machinery for the use of steam engine and steam pump builders.

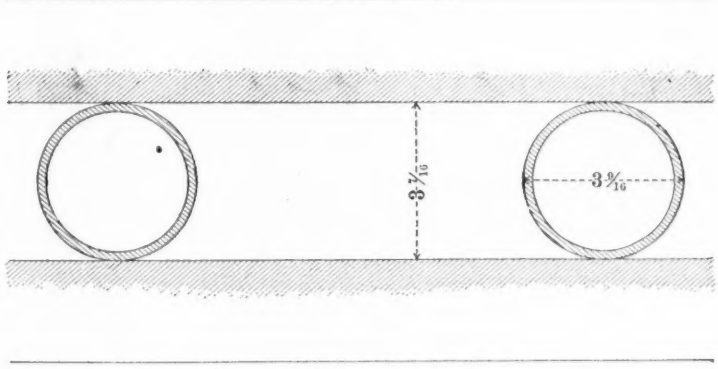
The cylinders of all the standard Corliss engines (made by about twenty firms in this country) are practically alike, and at least six of the high speed automatic engines have cylinders so near alike that a slight change in the table would give us a machine that could be used by all of these makers.

In the matter of steam pumps, the similarity of design is still more pronounced, as there are few pumps in the twenty-five or thirty varieties that cannot be built by a continuous cutting on a special machine. The most singular fact is, that the builders of the so-called cheap engine have not, as a rule, attempted to build their machines on the interchanging plan, and have thus far used a limited amount of special rapid cutting machinery. Had these builders during the past ten years adopted this system, we firmly believe that we would not to-day see a throttling governor engine, as all would be able to afford some kind of an automatic cut-off with their engine, for a price not above the present cost of the old style engine. But the builders of the cheap engine, we think, made a great mistake, and so far as these engines from 3 to 15 horse-power are concerned, it is too late to correct the mistake, for it is quite probable that in a very short time this class of engine will not be wanted in any locality where there is an electric current suited to motors.

Steam engine builders in general have been prone to think lightly of electricity as a motive power, and they have passed it by almost unnoticed, until now it suddenly turns to meet them face to face. Five years ago most any of our engine builders would have laughed at the idea of running a machine shop with an electric motor, yet there are several machine shops in and near New York driven by this power, the electric machine doing the work for about one-half the expense of the steam engine formerly used in these places. We cannot tell how soon the electricians will be ready to offer our customers motors from 30 to 60 horse-power, and therefore the builders of our first-class automatic engines of these powers must not make the mistake made by the small engine builders. They must improve their machines in every way possible, in design, in workmanship, and in the economy of production, thus placing them in a secure position to compete successfully with the new power.

As I have before stated, the high speed automatic engine is generally constructed on the system of interchangeability, but not usually by special machinery. The special methods should be adopted, however, and with their adoption the builder will realize the much needed economy in manufacturing, and will have a very satisfactory engine for continuous heavy service, at the same time the reduced cost of making will leave him a margin for a reduction in prices, when that course becomes necessary.

I said in connection with rapid and continuous tool cutting machinery, that more thought should be given to the matter of design, and this suggestion will hold good in the foundry as well as the machine shop. In designing the details of steam engines from 25 to 75 horse-power, the plain green sand casting made without the use of cores and dry sand work, should be introduced wherever possible. A pattern for a 40 horse-power high speed engine frame can be made so that a perfectly sound casting can be obtained with the entire absence of core boxes, and by using such a pattern we can always secure true and sound work. The setting of a core for the jaw of the main bearing of an engine frame is very frequently attended with bad alignment, thus requiring careful setting and adjustment when finished in the machine shop. No piston head should be cored in the body, as the thickness of such pistons is always a matter of uncertainty. The pattern should be open, and arranged to cast the radial ribs to the head-plate, the follower plate can then be fastened to the piston-head in any way to suit the fancy of the designer, and the same can be said of the cylinder heads, as these should also be cast open and arranged with a false finishing plate. Thus, if the designs are such that green sand castings can be used in the parts calling for the most foundry work, we have the item of the bulk of the material, together with the special machine shop methods, brought to a minimum of cost.



Spring Roller Problem.

LETTERS FROM PRACTICAL MEN.

A Spring Roller Problem.

Editor American Machinist:

I have a problem to solve, and have nothing in the way of practical experience or mathematics to base calculations upon, and so think it a good question to test the relative efficiency of good judgment and mathematics, except, perhaps, in this case the mathematician will have the advantage. The problem is simply this: For a certain purpose I wish to carry a load on slides, but to reduce the power required I propose to introduce spring rollers, which shall relieve the slides of a part of the weight to the extent of perhaps 3,000 pounds. There are four parallel surfaces $1\frac{7}{8}''$ wide and $3\frac{7}{16}''$ apart. If between these surfaces four spring steel rings, $3\frac{1}{2}''$ in diameter and each capable of sustaining a load of 750 pounds when sprung out of round to the extent of $\frac{1}{16}$th of an inch, be placed between the slides, the desired end will be accomplished.

The sketch shows the rings in working condition, and the question that I should like to have the mathematicians figure upon and the spring makers guess upon is this: How thick must the spring steel rings, which are $1\frac{7}{8}''$ wide and $3\frac{1}{2}''$ in diameter, be, to spring $\frac{1}{16}$th of an inch when loaded with 750 pounds? I have not the least doubt but the spring makers will be willing to guess upon it, and the mathematicians ought to be willing to figure, but will they? I shall try the experiment, anyhow, either with or without the figures, and simply propose the question to see how near the fellows who think the proper thing to do in such a case is to figure it out, and the other fellows who think they can guess better than any man can figure, will hit the mark.

John E. Sweet.

Overhanging Studs.

Editor American Machinist:

The discussion between "Easy Way" and A. J. Shaw, concerning the proper construction of overhanging studs brings to mind an experience which we had some time since, and which may cast a little light on the subject. In a certain machine was a stud about $\frac{1}{2}''$ diameter by 3" long necked down in the same manner as the stud to which Mr. Shaw so much objects. The stud was subject to an alternating load of considerable intensity at its extremity, and broke off in the neck after a very short run. It was replaced by another which broke almost immediately, and was followed by a third which behaved in the same manner. These were all precisely alike, except that the second and third had small fillets at the junction of the neck and body, which the first did not have. We then substituted for these a stud made from the same bar of steel as the others, on the "five piece plan," with a collar $\frac{1}{16}$ in. diameter. This showed no signs of weakness and is doing its work satisfactorily to-day.

In the light of this experience I should be inclined to agree with the conclusion arrived at by Mr. Shaw, that the ordinary form of stud is inferior in strength to the one with a collar, and should also agree with him concerning the relative merits of the third form shown in the original article and the "screw and thimble" modification suggested in "Easy Way's" letter.

Bruno Nordberg.

Three-Legged Tools—Boiler Setting.

Editor American Machinist:

I take great pleasure in reading the letters from practical men, published in your paper. They are very instructing; but to the statements in some, exceptions may be taken. Among the latter is one from John E. Sweet, advocating three legs for lathes and other machinery. Now the advocates of the three-legged lathes give as their plea that you cannot get an equal bearing on the floor with a lathe with four legs. This is absurd. What is easier than to drive one or more shingles under the short leg until it carries its proportion of the weight of the machine? For a lathe over fourteen feet long four legs are not enough. I think the more legs the better. Each one can be made to carry its proportion of the weight, in the manner spoken of above. What would be the result if a crank shaft, or any other piece of work that was sadly out of balance, was put in a lathe with only three legs, and run at a moderate speed? I think I know what you would say—you would want to get as far away as possible from it. Three legs may do for a milking stool, but not for a lathe.

I would like to get the opinion of some of your numerous readers, as to whether there is any benefit derived from an overhead draft on steam boilers; that is, passing the heat three times the length of the boiler, under the bottom; then back through the flues, and back again through a brick arch on the top. I contend there is no benefit. After the heat has passed under the boiler, then through the flues, it has lost so much of its force that in passing it over the top it becomes a condenser, and is colder than the steam in the upper part of the boiler. I know of a case of

three boilers that were set on the above plan, and they could not get the results that such boilers ought to give. About all the mechanical talent of the place was called upon to try and find out why the boilers did not do better. At last a hole was dug through the brick arch on the top of the boilers, a thermometer put down, and the temperature was found to be several degrees less than the steam in the boilers. Here was the grand secret. The boilers were re-set, the overhead flue being left out, and the change was so great that two of the boilers did the work formerly done by the three.

Benj. F. Hetherington.

Indianapolis, Ind.

[The question of flues over the top of horizontal tubular boilers has been discussed very generally for the past fifteen years. The majority of engineers do not approve of setting boilers with return over and in contact with the shell, not because of condensing qualities of the returning gases, but because it is feared that the sheets without water against them will be overheated. It is also claimed by some that with certain qualities of coal the sheets will be corroded. Under all ordinary conditions, the gases, as they leave the tubes, are a good many degrees hotter than the steam in the boiler, and it is generally possible to transfer a little of this heat to the steam. With boilers working moderately hard, and the temperature in the overhead flue lower than in the boiler, we should look for air leaks. These would cool the gases and impair the draft. While we do not approve of the overhead flue, it is no more than fair to say that we have known boilers set in that way which gave excellent results; we have known them in use, working hard, for ten years without any damage to sheets.]

Trouble Away from the Shop.

Editor American Machinist:

I think it would often be profitable for the foreman of a machine shop to go out and fit up some of his own work. He would then find out how many oil holes he had missed drilling, how many keys were misfits, how many shafts would not go down into their babbitt bearings, how many pulleys would not go on their shafts, how many went on too easy, how many things were actually wanting, how many bolts wanted jam nuts, how many teeth on wheels ought to have had the bumps filed off them to work smoothly, how many bevels were bored untrue, how many things were badly designed for easy erection in place, how many brackets or solid hangers had bunions on their feet, necessitating much cutting away of the timber grounds to make them hang plumb, how many solid hangers after they are bolted up plumb require to have $\frac{1}{16}''$ to $\frac{1}{8}''$ filed and scraped out of the bottom or side to get the shaft down to place.

All of the above suggested defects happened on a single small job. There is no end to the list of things of this kind, and if the foreman was a sensible man, he would see the vexation they give rise to, and go back to the shop a better foreman than he left it.

Not long ago a case of shop or foreman neglect caused hours of hard work and lost time to remedy. An upright shaft fitted with a bevel wheel was to be driven by a bevel pinion on a horizontal shaft. The pinion was loose on the shaft, and had a clutch on end of hub. A sliding clutch, fitted on a feather in the shaft, was designed to engage and disengage the clutch upon the pinion, by means of the usual groove and lever. Do you think that clutch worked smoothly into its place? No; before it got home, a very disgusted machinist lost a good deal of sweat and temper; and all because a foreman did not do his duty.

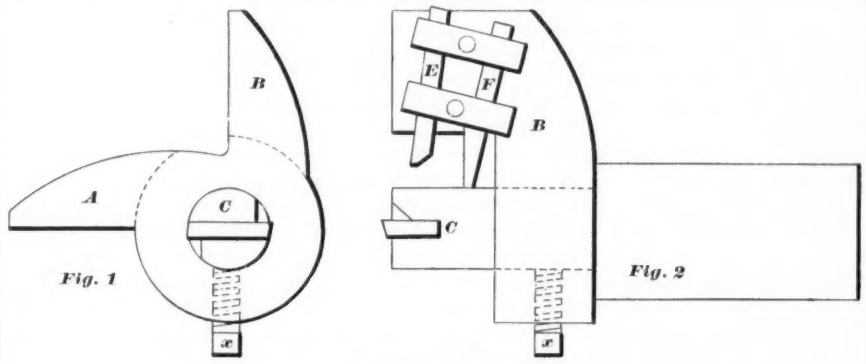
J. A. Caldwell.

Improved Milling Tool.

Editor American Machinist:

The accompanying sketch shows an improved milling tool for turret lathes. We have used the "one wing" style for several years, and the "two wing" for about one year. The improved tool has an additional wing at right angles to the first, as shown in Fig. 1, which gives a front end view.

Referring to the sketch in Fig. 1, *A* and *B* are the wings, *C* is central or guiding cutter, *x* set screw for holding same. Cutter *C* is very essential in nearly all work, except when so close to chuck that there is no "spring." In long work it acts as a guide and produces excellent results.



Milling Tool.

Fig. 2 is side view of same, and while, strictly speaking, it is an incorrect drawing, (as it shows but one wing) it is, I think, more easily understood. As both wings are similar, a view of the other is unnecessary.

The tools *E F* are cut from flat steel $\frac{1}{4}'' \times \frac{5}{8}''$ and ground to shape. The manner of holding them is plainly shown.

The object of the extra wing is to promote uniformity of size, avoiding creeping back of cutters (by dividing the work of each) thus saving the die from overwork, or cutting more than a thread.

Set *E* a little ahead of the corresponding cutter on wing *A*, and let it "rough," or not cut to required size, but leave it $\frac{1}{32}$ large. Set *E'* on wing *A* to finish, then should *E* creep back a little, *E'* will still finish to size. *F* is a facing tool, while *F'* on *A* is ground to "chamfer" or bevel for the die to start easily, thus avoiding the use of a hand tool.

Fred. H. Colvin.

Effect of Initial Strain on Bolts.

Editor American Machinist:

The question whether the initial strain on a bolt, due to its being screwed up, should be deducted from its ultimate strength or from its holding power is very apt to be a puzzling one to any one considering it for the first time. The annexed diagram may help to make the matter clear.

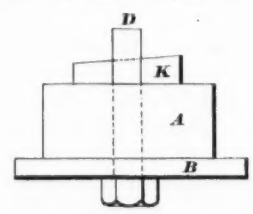


Fig. 2.

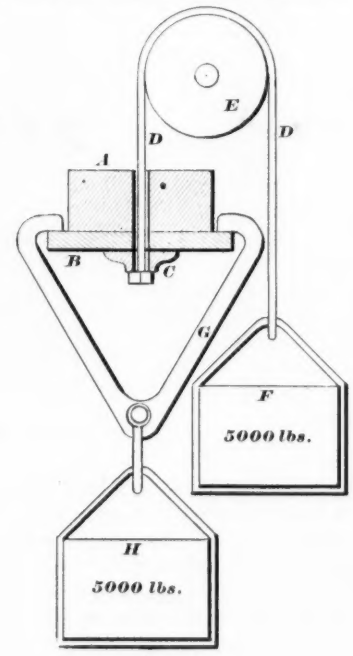


Fig. 1.

Initial Strain on Bolts.

Let *A* (Fig. 1) be a fixed block, say a small section of the end of an engine cylinder; *B* a movable piece, say a section of the movable head of same cylinder. The two are to be bolted together by a bolt screwed till there is an initial strain of 5,000 lbs. on it, and an additional strain say of steam within the cylinder equal to 5,000 lbs. more is to be brought upon *B*, tending to separate it from *A*. Will the strain on the bolt be 10,000 lbs. or only 5,000 lbs.?

For the bolt tending to hold *A* and *B* together substitute a wire rope *D D* running over a pulley *E*, and carrying a weight *F* of 5,000 lbs. For the strain tending to separate *A* and *B* substitute the yoke *G*, carrying a weight *H* of 5,000 lbs. It is now evident on inspection that the initial strain on *D* of 5,000 lbs. is not at all increased by the application of the load *H*, but remains the same.

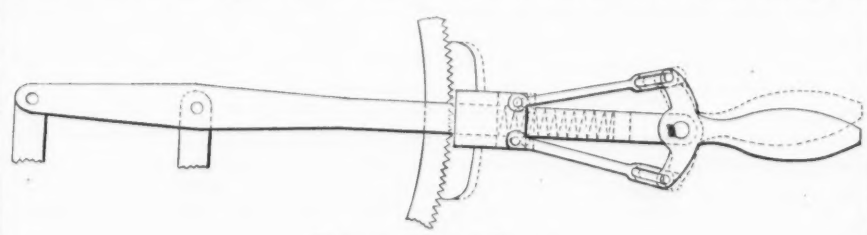
Another solution: Movable piece *B* (Fig. 2,) is held to fixed piece *A* with a strain of 5,000 lbs. by means of bolt *D* and cotter *A*. Hang the yoke *G* and weight *H* of the first case on *B*, and it will not increase the strain on bolt *D*.

Wm. Kent.

Throttle Lever Latch.

Editor American Machinist:

Referring to Mr. J. A. Hill's able and interesting article on "Throttle Latches," in American Machinist of August 6, I venture to submit a plan sketch of a device I designed and applied some years ago to the throttle of a hoisting engine that was in almost constant movement 18 hours per day. It is believed to be so clearly shown as to require but little description. It will be noticed that the handle of the lever is pivoted to the lever proper. Loop ended rods extend from the corners of the handle to the latch, to which they are pivoted. The latch is an internally notched section that engages with the usual stationary section. The latch is provided with a sleeve that slips over the throttle lever. A coiled spring, shown in dotted lines, is provided on the underside of the lever, that retains the latch normally in engagement with the notched section. Moving the handle in either direction, as indicated by dotted lines, causes either one or the other of the loop-ended rods to retract latch from engagement with notched section and enables throttle to be moved. As soon as pressure is removed from handle, the coiled spring locks the parts in position.



Throttle Lever Latch.

Care was taken to make the latch long, so that it engaged a large number of notches, and all pivots were large and long as possible. The device worked successfully for six years to my personal knowledge, and I presume is in use now. It was much preferred to the ordinary latch, though I am frank to say I do not know why. The engineer used to say that he could open or close the throttle with his foot, something he could not do with the old style. I subsequently applied the same device to the reversing levers of some small traction engines with gratifying results. There is no patent on the device.

W. G. S.

Air Valve in Suction Pipe.

Editor American Machinist:

The tribulations of "Engineer," with his long suction pipe, in your issue of 16th ult., reminds me of a little racket I once noticed on a piece of ten-inch pipe. One of the chaplets, with head $1\frac{1}{4}$ inches diameter and stem $\frac{5}{8}$ inch, was loose in the casting, the iron being somewhat stodgy around it; you could move it lineally about $\frac{1}{8}$ inch, but then it fetched up and would go no farther. If "Engineer" had such a complete little spindle valve in his suction, opening inwards, to be tight and stand all the pressure he could put on it when testing his suction by pressure, and then open to let in lots of air as soon as the vacuum went on, it would well account for his grief.

Lowell, Mass. Wm. P. Canning.

Our attention is called to an inaccuracy in our stenographic report of the proceedings of the Railway Master Mechanics' Association at St. Paul. The correct report of John S. Cook's remarks on the use of metallic packing should have read: "We have metallic packing on the pistons and valve stems of 25 locomotives; 23 having the "United States" and 2 the "Jerome."

The Yacht Shearwater.

This yacht, designed by Alfred Burgess, and built at the Atlantic Works, East Boston, for John M. Forbes, of Boston, is said by those competent to judge to be one of the prettiest small yachts ever built in this country. She is 129 feet long over all, 17 feet 11 inches breadth of beam, and is 10 feet 5 inches depth. She is built of steel, $\frac{1}{4}$ inch thickness of plates. Her engine is fore and aft compound, high pressure cylinder, $12\frac{1}{2}$ inches diameter, low pressure 25 inches diameter; stroke of both pistons 20 inches. The boiler is of the Belleville type; propeller 6 feet diameter, four-bladed. She has a Wheeler light-weight surface condenser alongside the engine, with Blake independent air and circulating pump immediately under the condenser.

We have seen some very excellent diagrams taken from these cylinders, working under 105 pounds boiler pressure, the revolutions of screw being 128. The horse-power developed in the high pressure cylinder was 83, and in the low pressure 70, vacuum 26 inches. This is not, however, full power.

First Water Works in the United States.

The oldest water works in the United States are supposed to be those at Bethlehem, Pa., which were built in 1754 by Hans Christopher Christiansen, a millwright, a native of Denmark, and being of historic interest we will enter into a description of it somewhat in detail. The water was taken from a spring issuing from the magnesium limestone near the banks of the Menogassi Creek, as it was then called. The water was conducted 350 feet through an underground conduit into a cistern, whence it was pumped by a lignum vitæ pump of 5 inches bore, through bored hemlock logs to a height of 70 feet, into a wooden tank in the village square. Trouble was experienced from the bursting of the pipes, and $1\frac{1}{4}$ inch pipes of sheet-lead, soldered along the edges and bedded in a cement of pitch and brick-dust, and laid in a gutter, were tried without much success

In 1762, Christiansen, aided by John Arbo and Marshall, constructed larger works. An 18-foot undershot wheel drove three single-acting force pumps of iron of four inches bore and 18 inches stroke. The force main was of gumwood and the distributing pipes of pitch-pine. The latter had to be renewed in 1769. In 1786, lead pipes were substituted for the gumwood force main, and for most of the distributing pipes. The last pitch-pine pipes were abandoned in 1791. The reservoir was a little wooden tower in the "little square." This was removed in 1803 and a stone tower built on Market street, about 15 feet high, in which was a tank, at an elevation of 112 feet above the spring. A reservoir was constructed, some years later, on higher ground, and the water tower abandoned. The triple pumps also were replaced by one double-acting pump. In 1868, steam power was used for pumping. In 1874, the wooden conduit from spring to the pump-house was replaced by an 18-inch iron pipe.—*Progressive Age.*

We learn that the Atlantic Dredging Company, of Brooklyn, N. Y., use graphite—without oil—in the cylinders of their engines, having surface condensers, the graphite lubricating the surfaces in a manner entirely satisfactory, and avoiding the trouble coming from getting oil in the boilers. They mix the graphite with water as a means of getting it in the steam chests and cylinders, and say that since using it they have no trouble with boilers fed from surface condensers.

The Weitmyer Smoke and Gas Consuming Furnace.

The engravings represent the practice of the Foundry and Machine Department, Harrisburg Car Manufacturing Company, Harrisburg, Pa., in boiler setting.

In this setting all the air for combustion is taken in at the rear of the setting, and following the course of the arrows under the flame bed, becomes heated before it enters the furnace, thus promoting combustion. A portion of the heated air, after passing through bridge wall arches into ash pit, is allowed to pass to the top of bridge wall through suitable openings; this air supplies the oxygen necessary for the combustion of the gases that would otherwise pass away unconsumed.

In operation the front ash-pit or draught door is always kept closed, so that no cold air can rush through any exposed part of grate to the detriment of the boiler and hindrance of proper combustion. The draught regulation is always by means of the damper in the stack or damper chamber.

It is claimed for this setting that it can be applied to any boiler setting without disturbing the exterior walls, and consequently at small cost; there are no hollow walls to crumble from the effects of expansion and contraction; there are no hidden or inaccessible air passages to fill up; no air pipes to be destroyed by heat; no forced draught is required. It will burn one-fourth bituminous coal, and three-fourths anthracite screenings.

This setting has already been applied to a number of boilers, and we are informed is giving entire satisfaction.

A model for a machine gun-carriage has just been completed at the United States armory. The carriage is the invention of Col. Buffington, as was the artillery carriage adopted by the government last year, and is ingeniously constructed, promising to revolutionize this feature of modern warfare. The carriage furnishes a complete protection to the gunners, and will render the men, who are working it, as safe as they would be inside an iron-clad.—*Springfield (Mass.) Republican.*

Breech-Loading Ordnance.

Our English contemporary, *Iron*, devotes considerable space to the description of a breech-loading gun upon which Mr. George Quick, a retired naval officer, has been for some years engaged. *Iron* believes a very decided advance has been made. We make the following extracts:

The gun, which weighs 14 cwt., was built of Firth's best crucible steel, by Messrs. Greenwood & Batley, from the designs of Mr. Quick. The gun consists of an inner tube, and a long jacket carrying the trunnions; the jacket and tube being connected together by shrinkage, and by a strong union nut securely locking the two parts together. It may be observed that this is the largest steel gun ever produced at the works of Messrs. Greenwood and Batley, and the results of the firing so far go to prove that it has been constructed in a highly creditable manner. Not only is the breech mechanism of the Quick gun on an entirely new principle, but the obturation is on a new design also, being an improvement on the Broadwell gas ring. In this new obturation the face of the breech-screw block (which is easily renewable) enters for a short distance into the rear face of the gas ring, which lies in the rear end of the powder chamber, against which ring it is securely pressed by the rotation of the breech screw. The gas ring itself, instead of being formed to a globular section, is cylindrical, the rear part being of larger diameter than the front end; and the two diameters are connected by means of an angular step, which forms a sort of valve face, which is forced up against a corresponding seating formed in the rear end of the powder chamber. By this arrangement a much thinner gas ring can be used than where the Broadwell system is employed, and consequently a much smaller recess is required in the gun for the reception of the Quick gas ring.

The firing apparatus consists of Quick's self-cocking, rebounding percussion lock, which is adapted not only for firing vent-sealing percussion tubes, but for using vent-sealing electric tubes also, no change in the mechanism being required for using either class of tubes. The great advantage of this lock is that it does not require to be cocked or re-cocked by hand, a single pull on the trigger line cocking and firing the lock instantaneously. Thus there is not only greater safety with the lock, but there is also much greater simplicity of manipulation, and, in case of a miss-fire due to a non-sensitive percussion tube (a circumstance of very frequent occurrence with the government vent-sealing percussion tubes), a second or third blow can be struck by the hammer on the tube in rapid succession before the object aimed at is off sight. This is a most important improvement, as, with the government lock, in case of a miss-fire a considerable time must elapse before the lock can be re-cocked by hand, so that the chance of a good shot may be lost, and the gun will probably require to be relaid, or trained again to bring it to bear upon the object.

Another perfectly new feature in this gun is that the firing-lock is brought into the firing position only by the action of the locking lever in locking the breech screw to the gun, so that, unless the breech be perfectly closed and the breech screw securely locked to the gun, it is quite impossible for the gun to be fired. There is thus no possibility of the danger of premature firing which hitherto has been the cause of so many disasters with guns of the French, Woolwich, and Elswick design. A reference to pages 87, 88, and 89 of the report of the Royal Commission on Ordnance, etc., will show how frequently the Woolwich vent-sealing tubes have failed; and further evidence of the continued failure of the Woolwich percussion locks and tubes is given at pages 135, 147, and 149 of vol. xxiv. of the report of the Ordnance Committee to the Director-General of Artillery. The extraction of the Woolwich vent-sealing percussion tubes and vent-sealing electric tubes has hitherto necessitated the use of a separate tool, and has in some cases been effected with much difficulty, as may be seen by reference to page 66 of the report of the Royal Commission on Ordnance; but in the Quick gun the extraction of the vent-sealing tubes is effected by the action of the locking lever when unlocking the breech-screw lever from the gun. Thus there is a saving of time and trouble in the extraction of the tubes after firing, and the working of the mechanism is much simplified.

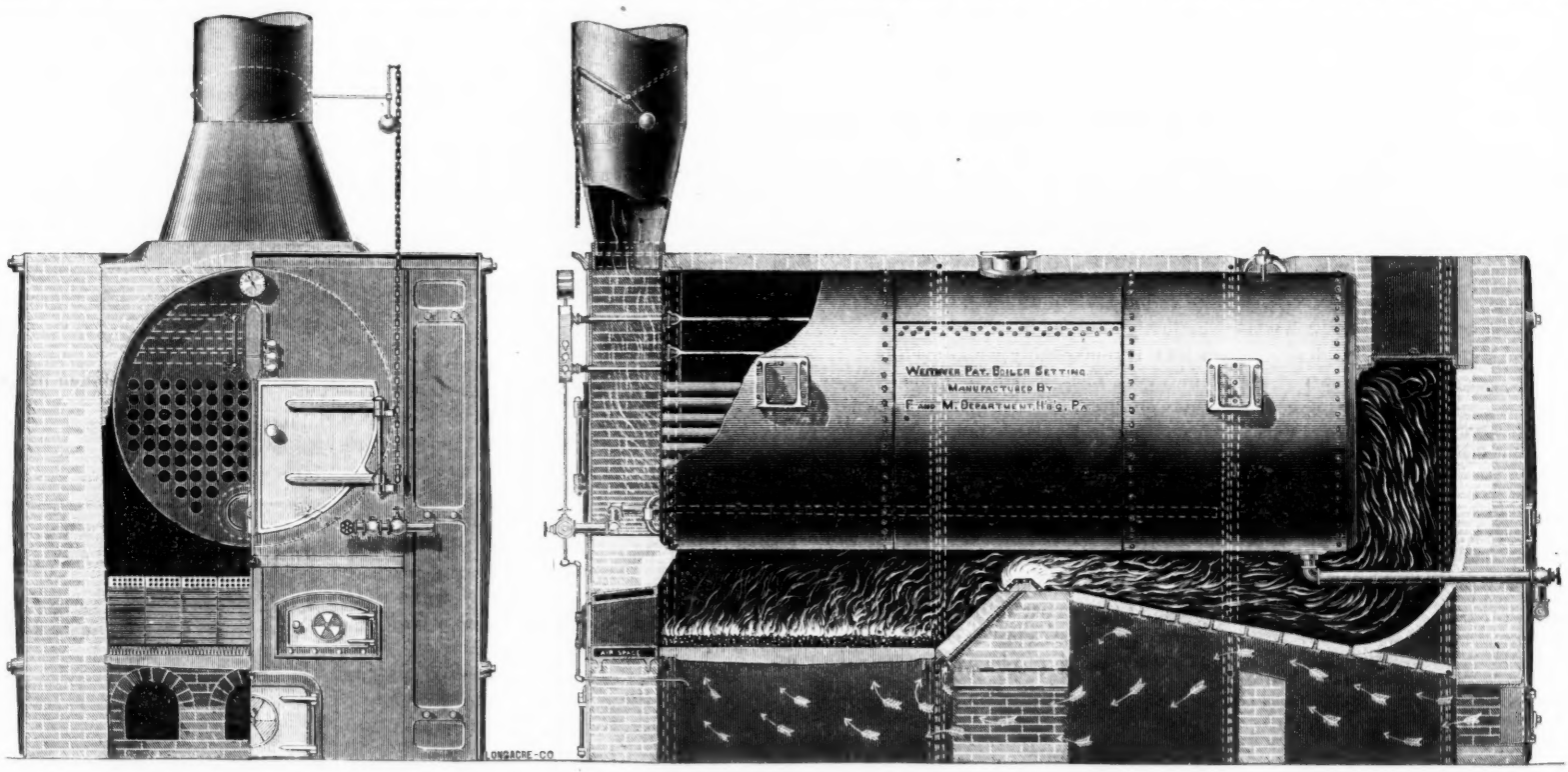
Mr. Quick has also devised a new form of powder, of which it is said:

This new description of powder, if powder it can be called, is in the form of circular cakes or disks, which are of the same diameter as the powder chamber. These cakes have a large central orifice, and are so arranged in building up the cartridge that those cakes with the larger central orifices shall come next to the projectile, the cakes with the smaller central orifices being next the breech screw, so that the air-spacing lies principally in the axis of the cartridge, that is, in the center line of the powder chamber, and is larger at the front end than at the rear end. These powder cakes lock into each other, but have certain small spaces arranged between them to facilitate the ignition and combustion of the charge. It is not possible now to enter fully into the details of the Quick powder and cartridges, but the results obtained would appear to show that a great and decided improvement has been effected in arranging the air spacing so as to bring the very first effort of the powder gas to act directly upon the base of the projectile the instant the charge is ignited, instead of the first pressure of the gas being permitted to drive forward the front part of the charge, and to crush up the powder of which it is composed.

The trial of the gun, which was made before a number of naval and military officers and other gentlemen interested, appears to have been quite satisfactory, notwithstanding this was the first gun made, and there was no preliminary trial.

Fire Protection in Small Towns.

Latterly we have given some attention, editorially, to the subject of proper fire protection in small towns and suburbs of cities. It is not often that a town is burned down twice within a few months, and both times from the same cause, namely, absence of facilities for putting out fires. An Indiana village has reached that proud distinction. Perhaps the citizens, in rebuilding after the first fire, relied upon the doctrine of averages, and assumed that they could skim along a few more years with no fire department, without much likelihood of another extended conflagration. But the doctrine of averages cannot always be relied upon to prevent fires from starting, or to put them out after they are started.



Smoke and Gas Consuming Furnace.

Professor in Physics (explaining a complicated machine to the students)—Please observe that the slender rod passes over to the second or smaller wheel, etc.; while this (turning vigorously) is the crank that sets the whole in motion! [Laughter from the students].—*New England Journal of Education.*

The companies which manufacture carbons for electric lighting have come to grief through their excessive greediness. They put the price so far above reason that the electric lighting companies have tackled the problem of making their own carbons.

P. S. Dingey writes us to say that the clause at about the middle of the second paragraph of the article "Making Hoisting Drums," in our issue of Aug. 6, should read. While the arms in end are loose, omitting the words "core" and "on."

It is said that 70 vessels arrive daily at Chicago during the season of navigation.

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NEW YORK, AUGUST 20, 1887.

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Too Much Competition Possible.

While a fair amount of competition is a good thing, there are plenty of examples to show that too much competition is likely to raise rather than lower prices; to deteriorate rather than improve quality. When one railroad is sufficient for all the business offered, the second road may cheapen the price for carrying for a time, but eventually there will almost inevitably be consolidation, or such an arrangement as will permit increase of prices beyond the original tariff. The reason is plain enough. By the construction of the second road twice as much money as is necessary to do the business is invested, the running expenses are nearly doubled, and with the roads it is a question of getting extravagant rates or losing money. Then again we have the modern "trust," about which no one seems to know anything in particular except that it is something devised to avoid responsibility and raise prices. When competition gets sharp in some of the great branches of industry the "trust" offers means of controlling prices and effectually preventing further competition. There is as much danger, in many things, from too much as from too little competition. Broadly speaking, it is unfortunate for the whole people of the country when competition reduces the price of any manufactured article below that which permits the manufacturer to pay liberal wages and make a fair profit, always supposing him to use the best means at hand in conducting his business.

Unprofitable Criticism of the Atlanta.

Those supposed to be responsible are subjected to a good deal of senseless criticism because the guns of the Atlanta, when fired, do damage to their surroundings. Since politically the responsibility seems to be about equally divided, the criticism may be justly charged to the fault-finding habit, which is remarkably well developed in this country. The efforts to build a navy for this country are compared to what has been done in England, but those who make the comparison forget the costly failures made there when the trade was being learned. Since anything to speak of has been done in naval architecture in this country the entire business has been revolutionized, and while there are plenty here who understand the theory of building war vessels, there is almost entire lack of practice. The trade has yet to be learned here, and it will cost money, in mistakes, in the learning. There is, however, no evidence that there has been any very serious mistake made in the instance of the Atlanta; a little lack of practical knowledge of the immediate effect of the explosion of large charges of powder, perhaps, but nothing for which a remedy will not be found, and in the end something will have been learned—and the knowledge paid for. The damage done to the Atlanta has been grossly overstated, and the condemnation has been on general principles, and without positive knowledge. It is a kind of criticism that is extremely cheap and productive of no good whatever. There is every reason to believe that the Atlanta is an excellent vessel of her class, and so few mistakes made in her construction and armament reflect credit upon her designers and builders. This appears to be the verdict of those best competent to judge.

The gamblers in wheat at Chicago, and cotton in Southern cities, succeeded in running the prices up sufficiently to throw the balance of trade largely against this country. The balance before this was largely in our favor. Of course this has a serious effect on business interests generally, and by and by a remedy will be demanded. We notice a good many honest people flatter themselves that because several large speculators lost heavily on wheat and cotton, such gambling will not be so common in the future. The hope is delusive. Exactly why people gamble—in wheat and cotton or in dollars and cents—is because some one is likely to lose. When this affects only the gamblers it does not matter so much. But when a gambler bets that he will make the whole country lose, and works to that end, the offense ought to be punishable.

Captain John Ericsson at Eighty-Four.

The spectacle of Captain John Ericsson working as busily and as effectively as ever he did, twelve hours a day, at the age of eighty-four, is invigorating and instructive in these times when men are apt to consider themselves old at seventy. It verifies what has often been remarked, viz., that hard work seldom kills a man, for Captain Ericsson has been pre-eminently a hard working man all his life. A good many rules are given for attaining length of years, but the Captain seems to have a plan of his own that works very successfully indeed. In the first place, he has always had a distinct end in view to the accomplishment of which he has worked hard, but in season. Beyond this he has lived temperately, and this appears to be about all there is of his plan. He has been beset by little of the worry that troubles many men, because he never doubts his ability to accomplish what he tries to do. His faith in himself is complete and well founded.

There is a warm place in the heart of every American for Captain Ericsson, and thousands of feaders will be glad to hear that he is as well and hearty as ever, with the prospect of years of usefulness before him. All the world is better for the fact that he has lived and worked in it, and we are sure that every one who reads this will wish him abundant success in the work he now has in hand, and about which little will be known till its completion.

Water Supply from Driven Wells.

It cannot have escaped the attention of those who are interested in such matters that the system of supplying towns and cities with water by means of driven wells is being very extensively put in operation at the present time. This system on quite extensive scales has been in operation long enough to test its practicability where the conditions are favorable. Under some circumstances the plan appears to compare favorably with that of getting water from above ground, unless in cases where the gravity system can be employed. Still where there is a visible supply reasonably convenient the wisdom of looking for a hidden supply would be questionable. But the driven well system may properly be considered in many towns and small cities where a supply of water from above ground cannot be had without going to a great distance, and at a cost hardly warranted. The question of whether it will be practicable to get a supply of water from driven wells can generally be settled at small expense, and in hundreds of cases would undoubtedly favorably settle a vexatious question.

It seems superfluous to urge the question of liberal water supply in a great many places where it is lacking. Nearly every city and town in the country aspires to become a manufacturing center. They will not all succeed, but amongst those that do will be only such as can furnish abundance of water at a low price. Water supply and protection against fire are necessities that must be provided for before manufacturers will, to any extent, consider the question of locating.

We learn from a friend in Canada that the inimitable Fink is still on his travels, being last heard from at Carleton Place, Ont. We presume the climate is congenial up there just at this season.

A movement is on foot to establish a national association of water and gas engineers and superintendents. Those desirous of connecting themselves with such an association are requested to correspond with E. C. Brown, 333 Walnut street, Philadelphia, Pa., Mr. Brown having consented to act as temporary secretary.

Literary Notes.

Poor's Directory of Railroad Officials for 1887 has been issued, and contains a great amount of useful information. In addition to lists of officers of all steam railroad companies in the United States and Canada, the book contains similar lists of officers of street railroad, express, sleeping car and equipment companies, boards of railroad commissioners, associations of railroad officials and railroad employes, and concerns engaged in the manufacture of railway supplies. It is published by H. V. & H. W. Poor, 70 Wall street, New York. Price, $2.00.

The *Universal Tinker* is the name of a new paper published at 294 Broadway, N. Y. The tinker is undoubtedly an important personage in the world, as it is now constituted, and there is no good reason why he should not have a journal devoted to his interests. We wish the *Universal Tinker* success.

The *Western Electrician* is a new claimant for public favor. It is published weekly in Chicago, at the low price of $2.00 per year; New York office, 181 Broadway. The first number presents a very creditable appearance, and its title is fully indicative of its contents. We hope it will find a field equal to the abilities of those who have it in charge.

Practical Directions for Winding Magnets for Dynamos. By Carl Hering. E. and F. N. Spon, 35 Murray street, New York.

We believe that this little work will be found of value to those interested in the subject treated. It sells for the low price of $1.25.

The *Implement Herald* is a new monthly publication devoted mainly to farm and household implements. It is published at Minneapolis, Minn., at $1.00 per year. It has a wide field, and proposes to cover it.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(342) W. C. B., Detroit, Mich., asks: 1. What makes new-plastered walls and ceiling turn yellow in streaks in a room in which a fire has been kept all winter? *A.*—The use of wet laths in building the house will often be the cause. 2. What makes the black stained water come out of my chimney? The chimney is new and I burn hard coal. *A.*—Badly-constructed chimney may be the cause.

(343) K. K. K., Atlanta, Ga., writes: I desire to get hold of some rule for calculating the area of smoke-stack. For instance, I have a brick stack 50 feet high and 24" square inside. Am using this stack for a large boiler with 72 three-inch tubes. Now, I want to know if this stack will be sufficient for *two* such boilers? If the area of this stack at its present height is not sufficient, will it not do by increasing the height, and if so, how much? *A.*—You should state the amount of coal you burn. The data are insufficient. You will find a table of chimney proportions, based upon coal burned per hour, in the American Machinist of April 23, 1877, or rules for calculating sizes in the issue of March 27, 1886.

(344) M. N. G., New Glasgow, Nova Scotia, writes: In your answer to I K., Question 287, in your issue of July 2d, as to how far he should place his stay-bolts apart, is it correct to proportion this distance without taking into account the thickness of the plates to be stayed? I do not think you had sufficient data to answer this question; for, if your answer is the correct one for plates ⅜ of an inch thick, would not the distance be too great if the plates were only ¼ of an inch thick, the working pressure being the same? Instead of first deciding upon size of the stay-bolt, should you not first decide how far apart the stay-bolts should be spaced for the thickness of the plates to be stayed

and pressure to be carried? That being settled, and the maximum working pressure per sectional square inch of stay known, the size of the stay-bolt is readily found. I would therefore say that, instead of deciding first on the size of the stay-bolt, we should first decide how far apart should the stay-bolts be placed, when the thickness of the plates to be stayed and the working pressure is given? *A.*—When the thickness of the plate is less than ¼ of an inch, and the pressure more than 150 pounds per square inch, then you must first find the space between the stay-bolts, as you suggest. But in ordinary boiler practice the thickness of the thinnest sheet to be stayed is seldom, if ever, less than 5-16 of an inch for boilers carrying a pressure of 150 pounds per square inch; often the thickness of these stayed sheets will be ⅛ of an inch and more; if now, for these plates, we first find the distances between the stay-bolts, the diameters of these stay-bolts may become so large as to make them too stiff, unable to yield to suit themselves to the difference in expansion of the sheets, and consequently will either work loose or break. In practice it is found that the best results are obtained when the stay-bolts are not less than ¼ of an inch diameter for thin sheets—say ¼ to 5-16 of an inch, and ⅜ to 1 in. diameter for thicker sheets. If these sizes are retained, and the spaces between the stay-bolts are found to suit these diameters, as we have explained in the answer to Question 287, there will be no danger of bursting the plates between the stay-bolts, providing we keep within the range of ordinary boiler work.

(345) T. A., Jersey City, N. J., writes: In connection with the answer to question 269, June 18th, 1887, I should like to give you my reasons for stating that .00113 is the loss percentage. First. We both agree as far as where we get the fraction .00113 as the part of a gallon lost in every gallon. We also agree that .00113×100=.113, the fraction of a gallon lost every 100 gallons, but from this point we begin to differ; so let us commence with this quantity of .00113, part of a gallon lost in every gallon. Now, to figure the percentage, we must take some quantity to represent unity or one (1); now in this problem the 10,206,417 gallons are assumed as unity or (1); when we divide 11,550 gallons by the 10,206,417, to find out what part of unity or one is lost, which is .00113 of unity or of one gallon. Therefore, 11,550 gallons bears the same relation to 10,206,417 gallons or its unity as .00113 of a gallon bears to one gallon or its unity. As both agree that .113 is the fraction of a gallon lost in every 100 gallons, let us take up your statement, namely, that if we lose one gallon in 100 gallons, we lose 1 per cent., and that if we lose two gallons in 100 we lose 2 per cent. Let me ask, How do we know we lose 1 and 2 per cent. respectively? This is how we know. We lose one unit in 100 units, and we find the per cent. by dividing the one unit (1) by the 100 units, which is 1-100, equal to .01 (expressed decimally). In like manner, we find the 2 per cent. (*A.*—We do nothing of the kind. In answer 269, we have stated that by percentage is meant the "allowance on a hundred;" therefore, if we know the number of units lost in every hundred units, we at once know the percentage; that is to say, if we know that one gallon is lost in every hundred gallons, we know that the percentage of loss is 1 per cent., and it is not 1-100, or .01 per cent. If we know the amount of loss for any other given quantity, which is greater or less than 100, we find the percentage by the rule of proportion, thus: If we lose three gallons in every 200 gallons, then, to find the percentage, we have 200 : 100 :: 3 : percentage; hence

$$\frac{100\times3}{200}=1\tfrac{1}{2} \text{ per cent.}$$

Or, if we lose three gallons in every 50 gallons, then, to find the percentage, we have 50 : 100 :: 3 : percentage; hence

$$\frac{100\times3}{50}=6 \text{ per cent.}$$

Now, applying this rule to the original example given in question 269, we have 10,206,417 : 100 :: 11550 : percentage; hence

$$\frac{100\times11550}{10,206,417}=0.113 \text{ per cent.}$$

And lastly, if we know that we lose .00113 part of a gallon in every gallon, then, to find the percentage, we have 1 : 100 :: 0·00113 : percentage; hence

$$\frac{100\times0.00113}{1}=0.113 \text{ per cent.}$$

as before.) T. A. further states: But in the problem before us we lose a quantity in 100 gallons which is less than unity (or quantity less than one gallon); it is, therefore, plain that if one part lost in 100 parts is 1 per cent., and we lose a quantity less than one part in 100 parts, we must certainly lose something less than 1 per cent., or 0.01. (*A.*—When you say that in the problem before us the percentage must be less than 1 per cent., you are correct; in fact, the answer 0.113 per cent. shows that the percentage is less than 1 per cent. But when you represent 1 per cent. by 0.01, or when you say that 1 per cent. is equal to 0.01 per cent., you are totally wrong. When we say that the loss is 1 per cent., then we mean that one whole part is lost in every 100 whole parts, and this percentage must be represented by 1 and not by .01, or any other fraction. In a similar manner, it can be shown that the remainder of your statement—which would require too much room in these colums to publish—is all wrong. We believe the answer here given will be sufficient and plain enough to convince you of your error.)

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

New Book for Machinists. See adv., p. 16.

Link-Belting.

Send for catalogue of Link-Belting.

Over 50,000,000 feet of Link Belt in use.

Link-Belt Machinery Co., Chicago and N. Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Air Compressors, Rock Drills. J. Clayton, 43 Dey st., N Y

Exhaust Tumbl'g Bbls. Henderson B's., Waterb'y, Ct.

Upright Drills from 20" to 36" inclusive. Currier & Snyder, Worcester, Mass.

For Improved Cooper Stoves, send to Variety Machine Co., Warsaw, N. Y.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N Y

Solid Nickel-Seated "Pop" Safety Valves. Consolidated Safety Valve Co., 111 Liberty st., Y. N.

Robbs' Patent Composition for case-hardening. Send for circular. F. W. Tasney, Paterson, N. J.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Injectors, Ejectors, Oil Cups, Sight Feed Lubricators, etc. Arthur Appleton, 45 Cortlandt st., N.Y.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 120 Liberty st., N.Y.

Ice and Refrigerating Machines. 124 built, and all successful. David Boyle, 521 Monroe St., Chicago, Ill.

Drawing Materials, all kinds. Get catalogue. Mention this paper. G. S. Woolman, 116 Fulton st., N. Y.

The Improved Tabor Steam Engine Indicator, made and sold by The Ashcroft Mfg. Co., 111 Liberty st., N. Y.

Metallic Pattern Letters and Figures to place on patterns for castings. Knight & Son, Seneca Falls, N. Y.

We offer $20 for the best model of Calipers. For terms, address E. H. Randall & Co., 154 Lake st., Chicago, Ill.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large; prices low. Frasse & Co., 92 Park row, N. Y.

Economy Dry Rooms or Kilns are the best; built by M. L. Senderling, 183 Fourth st., Jersey City, N. J. Write for estimates.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

Machinists' supplies, brass goods, m'f'rs' supplies, polishing materials, all kinds wire, metals, etc.; in any quantity. Jordan & Gottfried, 208 Canal st., N.Y.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N.Y. Send for des'n.

The Holly Manufacturing Company, of Lockport, N. Y., will send, on application, their pamphlet illustrating pumping machinery and reports of duty trials.

Press for sale. Quick-acting; hole in bed, 8x5, punches to center of 13-inch sheet; 2¾-inch shaft; also four-spindle Drill. B. W. Payne & Sons, Elmira, New York.

Reed's Engineer's Hand-Book to the Local Board Examinations. Eleventh edition revised and enlarged, with 260 diagrams and 36 large plates. 8vo., cloth, $4.50, post-paid. Catalogue of books free. E. & F. N. Spon, 35 Murray st., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2 post-paid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

MANUFACTURES

Water-works are wanted at Clinton, Wis.

Lexington, Va., want enlarged water-works.

Kalamazoo, Mich., is moving for better water-works.

The Janesville (Wis.) Water Company has been incorporated.

An iron fence manufactory is to be erected at Plattsmouth, Neb.

Lafayette, Ind., contemplates spending about $50,000 on water-works.

The citizens of Sparta, Wis., are demanding a pump for fire protection.

Over $200,000 are to be spent at St. Louis, Mo., in extending the water-works.

T. F. Howell is interested in forming the Anniston (Ala.) Compress Company.

The Excelsior Foundry and Machine Works at Avondale, Ala., will be enlarged.

The Baton Rouge (La.) Foundry, recently destroyed by fire, will be rebuilt at once.

The Canisteo (N. Y.) Water-Works Company is incorporated, with a capital of $25,000.

C. O. Godfrey is interested in a company to erect a saw and planing mill at Fort Payne, Ala.

The American Refrigerator and Construction Company will erect a plant at Anniston, Ala.

B. Fritz will build a foundry to be used in connection with his machine shop at Worcester, Mass.

Work is progressing on the new tobacco scrap machine factory of Zimmermann Bros. at West Troy, N. Y.

Files, Taylor & Files is the title of a new company that will manufacture cotton compressors at Hillsboro, Tex.

The Kalamazoo (Mich.) Wagon Company are to add to their capacity by erecting a five-story building, 65x250 feet.

The Daley Manufacturing Company has been incorporated to manufacture agricultural implements at De Kalb, Ill.

The Burton Car Company, of Boston, Mass., have concluded to locate works at Wichita, Kan. They expect to employ 2,000 men.

C. M. Boutwell, Greenfield, Mass., has secured the old Munson Manufacturing Company's property, and will put in planing mill machinery.

The Davis-Gurney factory at Whitman, Mass., has been leased by Thomas W. Crocker. He will put in machinery for manufacturing paper boxes.

A. D. Catlin, formerly of the Standard Machinery Company, and others, will erect a machine shop plant in Chattanooga, Tenn., for the manufacture of special saw mill and wood-working machinery.

The stockholders of the Page Belting Company, Concord, N. H., have voted to ratify the action of the officers in increasing the capital stock to $300,000.

Edward Kendall & Sons, Cambridge, Mass., recently furnished the Union Cotton Manufacturing Company, of Fall River, Mass., with eight steel boilers 72 inches diameter.

The New Haven (Conn.) Clock Company have started up their works in all departments. The works have been shut down for five weeks. Prospects for business are said to be promising.

The Holly Manufacturing Company, Lockport, N. Y., have built a new erecting shop, 100x105 feet; also an addition to their foundry, 70x150 feet. They will employ an additional number of machinists and moulders.

The Skinner Chuck Company, a corporation recently formed at New Britain, Conn., will manufacture Skinner's patent lathe and drill chucks. D. N. Camp is president; D. D. Rogers, treasurer; E. J. Skinner, secretary.

The Hawley Silk Manufacturing Company, of Hawley, Wayne county, Pa., has purchased sixteen lots of land on Hancock and Sherman avenues, Jersey City, N. J., and the Paterson Plank road, with the view of erecting an extensive silk mill.

The Tingue Manufacturing Company, of Seymour, Conn., is having pipe laid from its mill to the Naugatuck Railroad, to carry oil for use as fuel. Large storage tanks will be sunk in the ground near the boilers, and the oil pumped direct from the cars through the pipes into the tanks.

William Tod & Co., Youngstown, Ohio, are to make still further additions to their works to accommodate their increasing business. Amongst other orders they recently received, was one for a 750 horse-power Porter-Hamilton engine for the Bessemer Rolling Mill Company, Birmingham, Ala.

The E. Walker Tool Company, Erie, Pa., will remove soon to their new shops on Fourth street, a company with a capital of $50,000 having been formed. The company will put in approved machinery for manufacturing a large line of small tools, gauges, etc., for machinists, carpenters and mechanics generally.

Post & Co., Cincinnati, Ohio, have issued a 528-page catalogue, finely bound, illustrating the immense line of goods handled by them. They handle all kinds of railway and machine shop supplies and equipment, steam engines, boilers, metals, fire equipment, etc. It is one of the most complete catalogues published.

At Meriden, Conn., the Miller Bros. Cutlery Company intend to build an addition to their factory. E. Miller & Co. will also build an addition. Manning & Bowman are putting up a connecting shop between their two main buildings. The Chas. Parker Company have just completed a new shop. Foster & Merriam have recently sunk an artesian well.

Gibson Bros., mining engineers, Honda, Colombia, South America—New York address, P. O. box 1,705—have applied to us for information regarding ways and means for boring for oil and gas on the most approved American plan. They also propose starting a paper mill and some other manufacturing industries, and will look for machinery.

Henry S. Ferrar, of the Fulton fisheries, fourteen miles below Jacksonville, Fla., and Capt. Yates, who has for some time been engaged in the menhaden fisheries north, have leased Calypso Island, in the St. Johns River, for a term of years, and will purchase the machinery necessary to begin a fertilizing factory. They will begin on a small scale, and enlarge as the success of the enterprise may justify.

The Mathuen Company, Mathuen, Mass., have placed an order with the Stilwell & Bierce Manufacturing Company, Dayton, Ohio, for a pair of their 25" horizontal Victor wheels, to develop 400 horse-power. These wheels displace an overshot wheel 38 feet diameter, 14 feet face. This company have built up a large business in their horizontal wheels, as it does away with all gears and belts direct to the main shaft.

One of the chief officers of the Atchison, Topeka and Santa Fe road is reported as saying: "Within two years, by the end of this year, we shall have built 3,000 miles of new road. That is what we planned to do, and our plans have not changed. The new road has been built by the company itself for cash. This new road needs equipment, and the company has issued stock for the purchase of it. This new stock represents the new road as well as equipment.

The Citizens' Match Company, Troy, N. Y., has been organized. The capital stock paid in is $50,000. The officers of the company are as follows: president, J. K. P. Pine; secretary, William E. Hagan; treasurer, H. H. Darling; directors, John D. Spicer, H. H. Darling, J. K. P. Pine, J. Wright Gardner, W. E. Hagan. The company's factory at West Troy is completed, and machinery is being erected. The manufacture of matches will begin in September or October.

The number of joint stock companies recorded at the Secretary of State's office for Connecticut since June 1 is large. Among them are the Bridgeport Rolling Mill Company, capital stock $50,000, to manufacture iron and steel; the American Rolling Stock Company, Stamford, capital stock $10,000, deal in and use railway cars, etc.; Norwalk Pottery Company, Norwalk, capital stock $10,000, pottery; the Danbury Lime Company, Danbury, capital stock $6,000, limestone quarrying.

According to the Springfield *Republican*, manufacturing all over Connecticut is brisk, but especially so at Meriden. The Æolian Music and Organ Company was formed yesterday, with Jas. Morgan, of New York, president, and a paid-in capital of $150,000. The company will at once proceed to erect a large factory. Word also comes that James Murray, late of Murray, Gill & Bros., of Philadelphia, is coming at once with a large force of men to occupy the factory of the Meriden Flint Glass Company for two years, to make lamp shades and chimneys.

L. S. Starrett, Esq., has bought out the patents, plant, machinery and stock entire of Chas. B. Fay, of Springfield, manufacturer of the "Fay Patent" and "Yankee" caliper and dividers, and will soon move the entire business to this town [Athol, Mass.] Some thirty men have been employed by Mr. Fay heretofore, and the business is likely to prove of value to the town as well as to Mr. Starrett. Athol seems to have a national reputation as a manufacturing center for patented articles, and our machinists as a class deservedly rank high in their special departments.—*The Worcester (Mass.) Chronicle.*

The Valley City Street and Cable Railroad Company, of Grand Rapids, Mich, will begin building their lines at once. Two boilers of 200 horse-power each and an engine of 375 horse-power will be required for the cable line. The engine house will be located on Lyon street, near Union. A. W. Eggleston, superintendent of construction, is at work getting out the various bills for lumber, preparatory to erection of the engine house. The company will use the regular Phœnix grip rope cable, the same as used upon the Chicago and St. Louis cable lines, and the equipment will be in all respects very similar to that of the cable lines of these cities.

On Monday the foundry at the corner of River avenue and Main street, Allegheny, Pa., started under a new name. On last Saturday the Campbell Manufacturing Company sold out their establishment to Mr. J. J. Kish, the iron and steel broker, who immediately assumed control. The former owners worked fifteen men at window weights and small iron castings. It was called a jewel foundry. Mr. Kish intends to add a couple of cranes to the foundry and build another cupola outside the building, so that any sizes of iron can be thrown in instead of having to break it up, as at present. Mr. Kish will transform the works into a general foundry, and probably add a machine shop to the other departments, besides other extensive improvements.—*American Manufacturer.*

Mr. W. F. Boysen, formerly connected with the St. Louis Malleable Iron Works, has associated himself with several others, and formed the St. Louis Novelty Manufacturing Co. A large two-story building on Sixth street, near Poplar, has been leased, and the same is being transformed into extensive works. The motive power is furnished by an electric motor. The company will be ready for business in a few days, and will manufacture light gray iron, malleable and brass castings. They will also pay particular attention to pattern and model making. The japanning, bronzing and nickel-plating department is to be fully equipped and only the best kind of work turned out. At present the foundry is in full blast, and a great deal of small castings turned out. The company has done but little canvassing, yet have already some orders, and are not afraid that they will be left. The company is composed of young and energetic business men, who are bound to succeed.—*Industrial Gazette.*

Machinists' Supplies and Iron.

NEW YORK, Aug. 4, 1887.

The only thing that has appeared to influence manufacture in iron is the hot weather of the past few weeks: this has caused cessation of work in a good many instances.

American Pig—Prices for standard brands continue firm. We quote No. 1 X Foundry, $21 to $22, with $21.50 ruling price; No. 2 X, $19.50 to $20.50; Grey Forge, $17.50 to $18.

Scotch Pig—But little is doing in Scotch brands. We quote Coltness, $22.50 to $23: Gartsherrie, $21.50 to $22; Summerlee, $21.50 to $22: Eglinton, $20.50 to $21; Dalmellington, $20.50 to $21.

Lead—Prices are nominal, there being no business of consequence. Common Western is held at 4.65c., but there are no takers at this price.

Antimony—Hallett's, 8½c; Cookson's, 9c. to 9½c.

Copper—The market has ruled dull. Lake has been offered at 10½c., without takers; casting brands are held at 9⅝c. to 9¾c.

Spelter—Refined, 5¾c. to 6c.

Tin—Jobbing lots of Banca have sold at 24c.; Straits and Malacca, 23.75c.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate, 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Six first-class machinists; none others need apply. Deane Steam Pump Co., Holyoke, Mass.

Competent machine shop foreman wants engagement; any class of machinery. Address Box 45, AM. MACHINIST.

Wanted—Machine draftsman; must be rapid, intelligent and of steady habits; reply, stating experience. P. O. Drawer 5,110, Boston, Mass.

Draftsman, experienced on machine tools, special machinery, mining machinery and miscellaneous work, desires engagement. Address Box 48, AM. MACHINIST.

Wanted—Two experienced foremen for machine shop and pattern room for Harvester Co. Address, stating age, previous experience, references, and salary expected, M. H., AM. MACHINIST.

Mechanical draftsman, graduate M. E., with first-class references, wishes a position; able to take charge of drawing office; can act as assistant superintendent; shop experiences; can offer knowledge against capital. F. E., 24, AM. MACH.

Wanted—For a small foundry in Eastern Canada, a working foreman; must thoroughly understand dry and green sand work; no plate work; give references; state experience, and wages expected. Address Founder, AM. MACHINIST.

Wanted—A competent foreman for an iron foundry (in New England) employing about 30 moulders, and doing a jobbing business principally in machinery work. Address, stating age, previous experience, references, and salary expected, Box 46, AM. MACHINIST.

Wanted—A man who thoroughly understands laying out all kinds of boiler-work, and who is competent to look after the fitting up of the work; none but a competent man need apply; give references and salary expected. Address Boilermaker, care AM. MACHINIST.

Wanted—By a firm mfg. engines and mining mach'y in a Western city, a thoroughly competent tool dresser to dress tools for 100 men; one experienced in handling and tempering steel; steady employment to the right man. Address, with references and expected pay, Box 47, AM. MACH.

Young man (28), thorough machinist and toolmaker, 3 years in charge of shop with satisfactory results, capable of making accurate drawings, knowledge of mathematics and practical use of same, wishes position after Aug. 15, where man of brains and good character, with above qualifications, is needed. J. H., 1907 Berks st., Phila., Pa.

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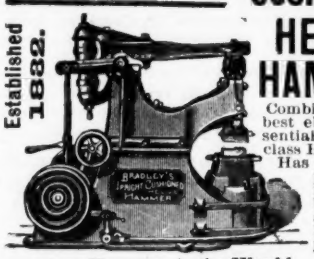

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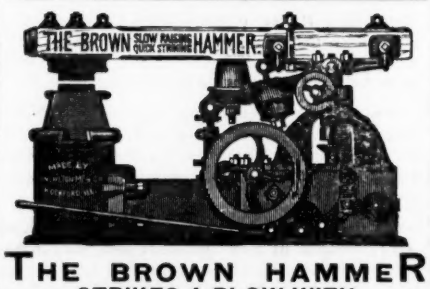

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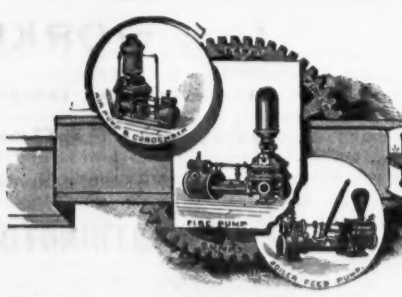

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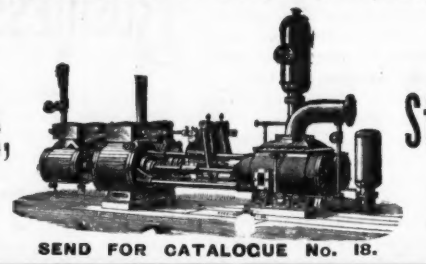

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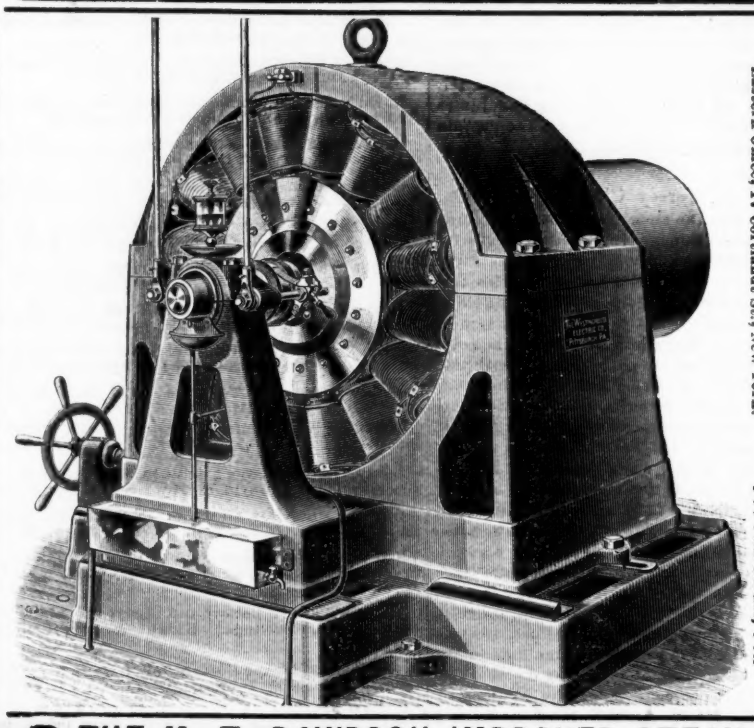

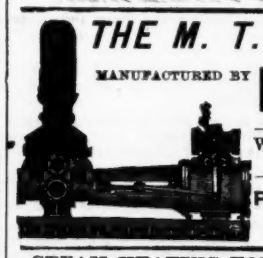

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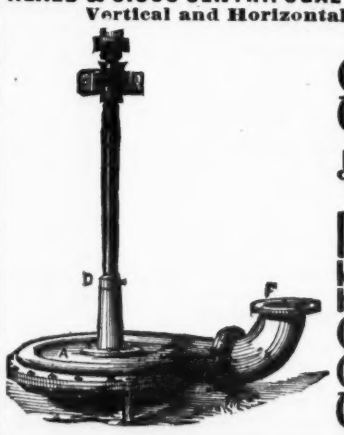

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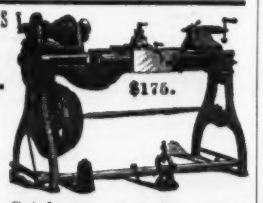

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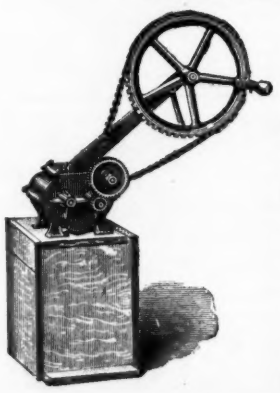

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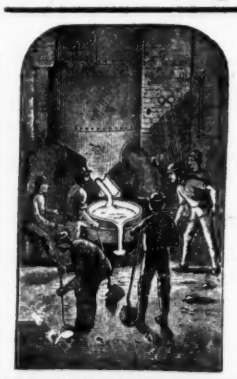

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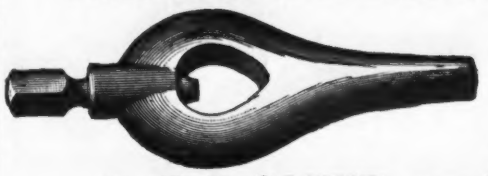

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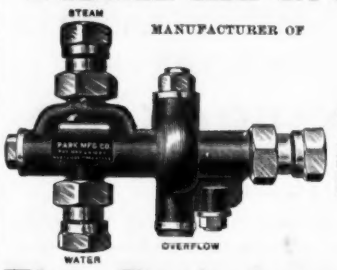

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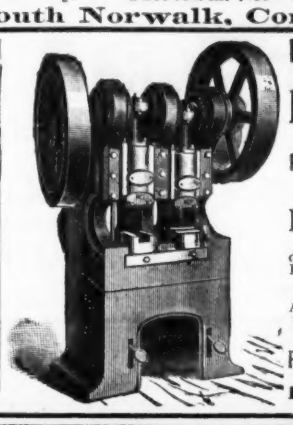

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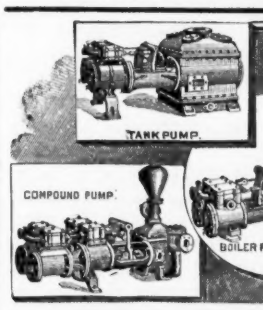

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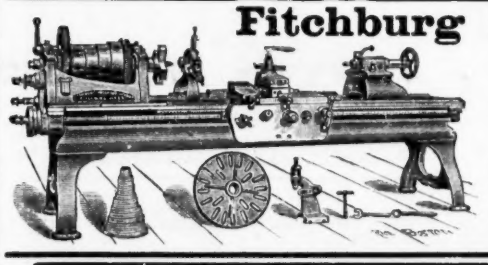

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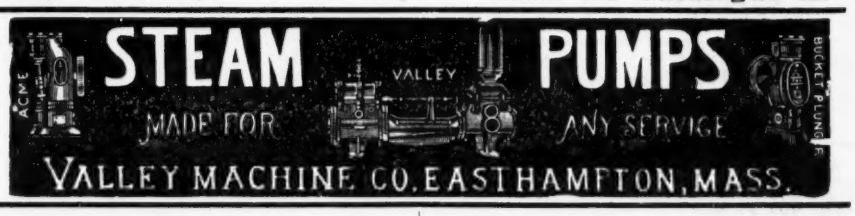

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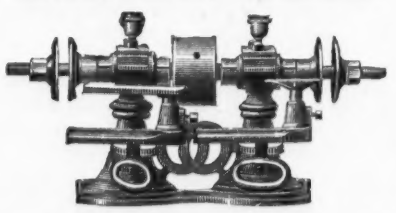

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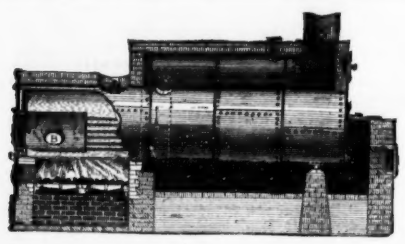

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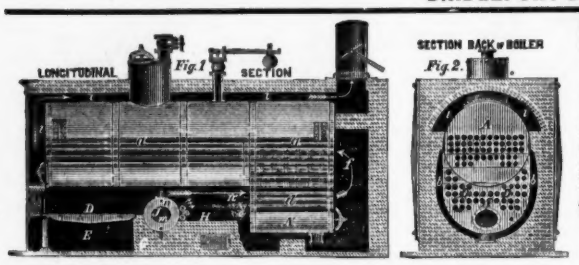

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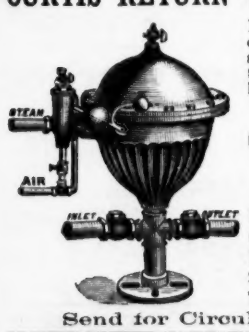

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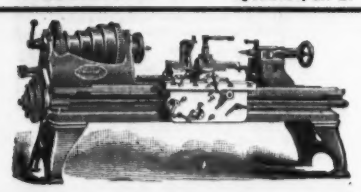

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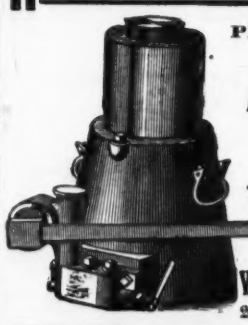

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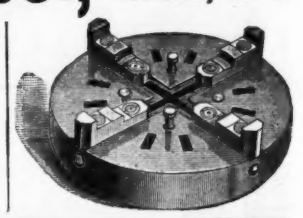

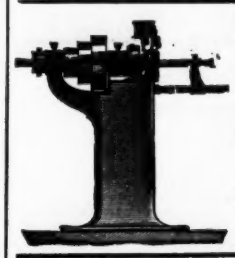

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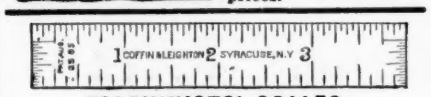

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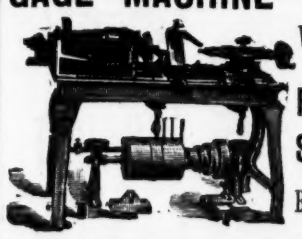

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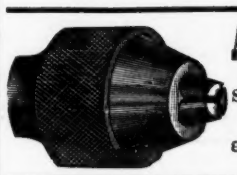

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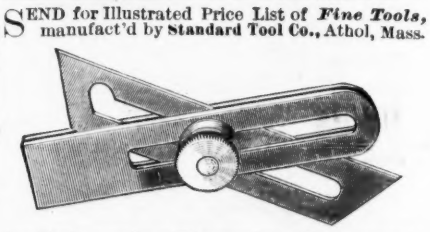

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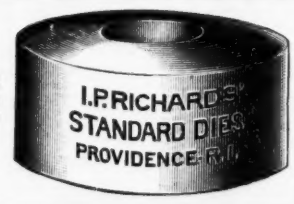

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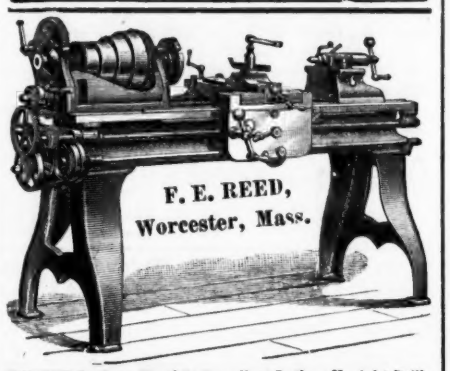

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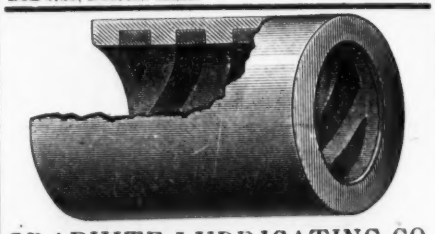

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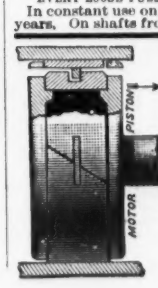

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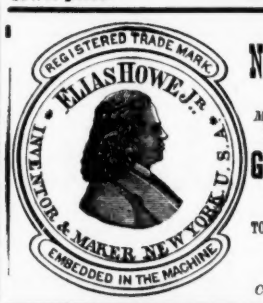

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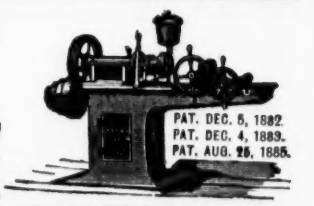

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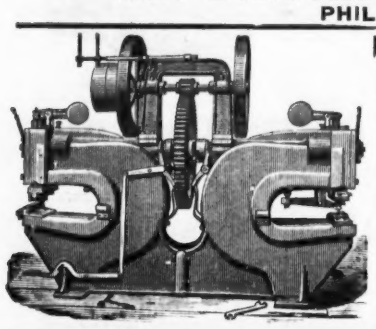

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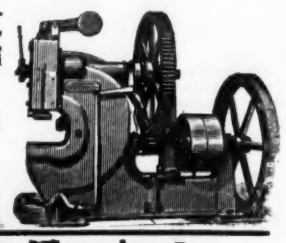

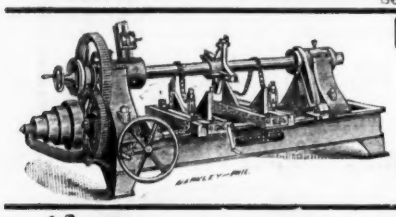

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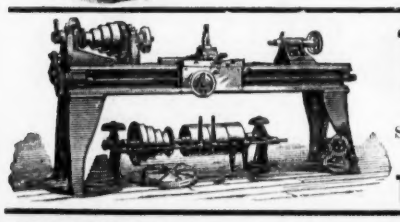

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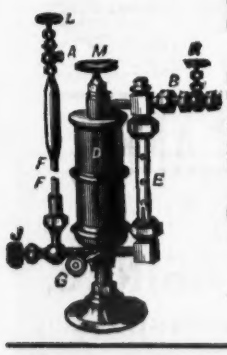

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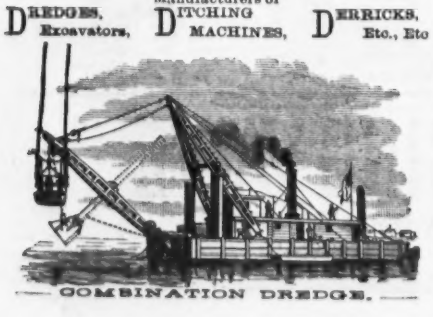
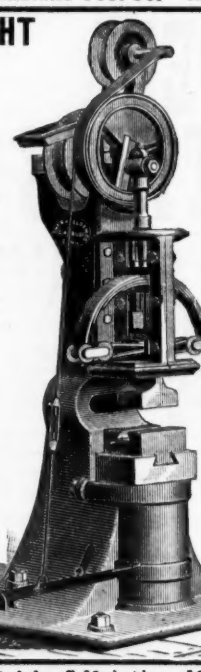


COMBINATION DREDGE.

UPRIGHT POWER HAMMER.



This Hammer possesses advantages superior to any other in the market. It has neither cylinders, valves or piston rods, consequently repairs are trifling. It takes up less space, less power to drive; strikes much harder and truer blows than hammers with double the weight of ram.

It can be worked to strike good alternate blows on a 3-inch and 3½-inch bar when a 100-pound hammer is used, and can be used on die work to a far greater advantage than any other hammer known. Manufactured by the

R. A. BELDEN CO., Danbury, Conn.

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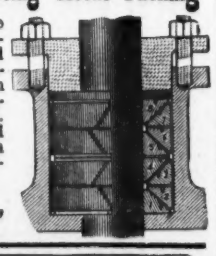

For Piston Rods, Valve Stems, etc., of Steam Engines, Pumps, etc., adopted and in use by leading engine builders, mills, iron works and steamship companies all over the world. Also flexible tubular metal packing for slip joints on steam pipes, and for hydraulic pressure.

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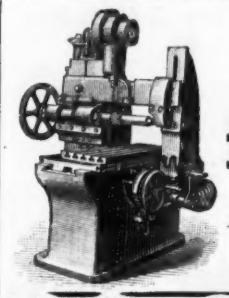

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The Open Side Iron Planers.

Adapted for all classes of Machine Work, and especially for a large amount of the EXTRA WIDE and HEAVY WORK necessitating the Large and Costly Planers of the regular style.

The QUALITY and QUANTITY of work performed on these Planers is GUARANTEED to be UNEXCELLED by that done on the modern tools of the very best makes.

Prices, phototypes and detailed information on application.

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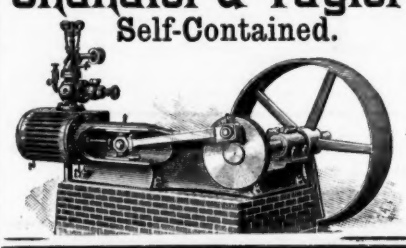
Chandler & Taylor's STEAM ENGINES

Self-Contained.



Are Strong, Well-Built and Serviceable.
Are designed for Heavy and Continuous Work.
May be run at High Speed when desired, performing the duties of High Grade Engines,
And are sold at the prices of ordinary Engines.

For Prices and Descriptive Circulars, address

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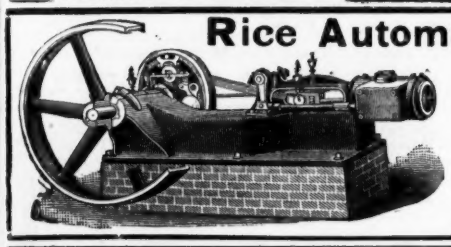
Rice Automatic Cut-off Engine



Self-Contained. Sensitive Governor.
Balanced Valve. High Speeds.
Stationary Oilers. Best Economy.

Gold Medal Cincinnati Exposition, 1884.

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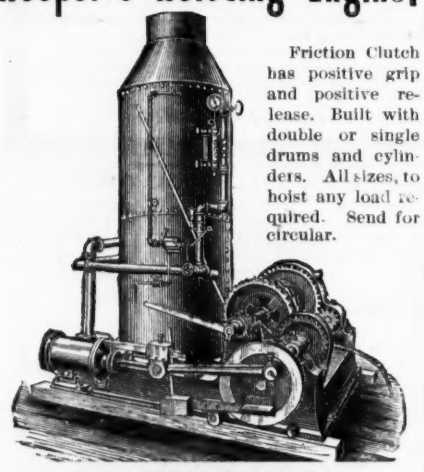

Friction Clutch has positive grip and positive release. Built with double or single drums and cylinders. All sizes, to hoist any load required. Send for circular.

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KORTING GAS ENGINE.

12 sizes,
1 to 60 H. P.

Thousands in use in Europe, and 36 engines running in New York City.

Satisfaction guaranteed.

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NEW YORK

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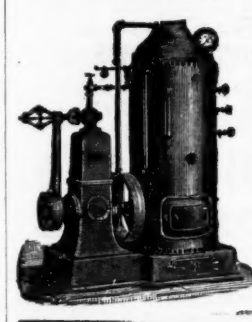

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Size: 1 to 10 H. Power.

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FOR HEAVY WORK AND LARGE POWERS.
EXTRA HEAVY DESIGN.
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PORTABLE AND STATIONARY
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BARGAIN LIST,

One Gray & Wood's Planer 22" wide 14' long, Second Hand.

"	Plain Milling Machine		"	"
"	Hand Planer 18"x18"x24"		"	"
Two	70 H.P. Stationary Boilers		"	"
One	60 "	" "	"	"
"	20 "	Coil "	"	"
"	20 "	Stationary Engine	"	"
"	15 "	Vertical "	"	"
"	12 "	" "	"	"
"	10 "	" "	"	"
"	12 "	" "		New.
"	35 "	Center Crank "		"
"	25 "	" " "		"
"	15 "	" " "		"

" Portable Saw Mill with Saw, Belts and Fixtures complete.

S. L. HOLT & CO.
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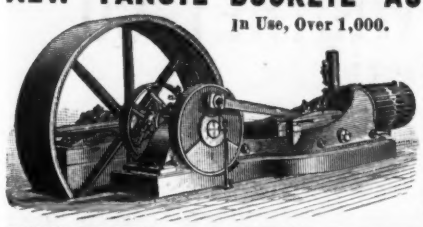
NEW TANGYE BUCKEYE AUTOMATIC CUT-OFF ENGINES.

In Use, Over 1,000. 25 to 1,000 H. P.



These engines are the combined result of long experience with automatic cut-off regulation, and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-contained Automatic Cut-off Engines 12 to 100 H P. for driving Dynamo Machines *a specialty*. Illustrated Circulars, with various data as to practical Steam Engine construction and performance, free by mail. **Address, BUCKEYE ENGINE CO., Salem, Ohio.**

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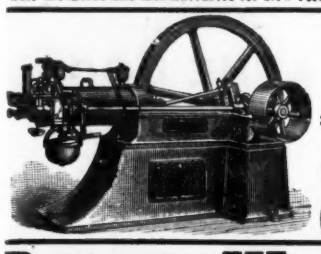
KENSINGTON ENGINE WORKS, LIMITED, PHILADELPHIA.

Sole Licensees and Manufacturers for New Jersey (South of Trenton), Eastern Pennsylvania, Delaware, Maryland and Virginia.



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OVER 20,000 ENGINES IN USE.

GUARANTEED To Consume 25 to 75 Per Cent. Less Gas than ANY Other Gas Engine doing the same work.

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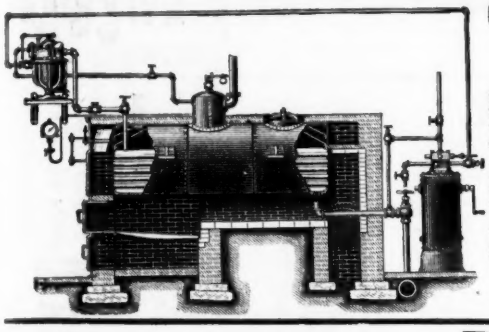

Guaranteed to Absolutely Prevent Formation of Scale in Steam Boilers.

Automatically takes water from the boiler, filters it, and returns it in pure condition, thus removing scale-making impurities from the water, and maintaining a free and steady circulation. Combines the well-known Albany Steam Trap with a Filter of novel construction, which has no rival in point of simplicity, facility for cleaning, and assurance against clogging of sand valve.

We also manufacture the **Albany Steam Traps** and **Blessing's Patent Renewable-Seat Stop and Check Valves.** Send for Circular.

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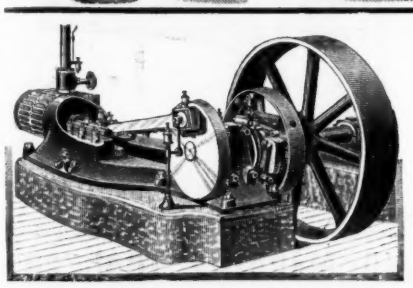

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Complete Power Plants Furnished and Erected.

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THE BEST

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Portable Drills,

ALSO FLEXIBLE

BORING MACHINES

For Ironing Carriages and Wagons; Boring for Pinning Sash, Doors and Blinds, also for Stair Work.

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NEW AND SECOND-HAND, ON HAND.

12 in. x 6 ft.	Engine Lathe,		new.
13 in. x 6 ft.	"	Ames,	"
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16 in. x 6-8-10 & 12 ft.	"	Bridgeport,	new
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20 in. x 10 ft.	"	Lathe and Morse,	fair.
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24 in. x 10 14 & 20 ft.	"	Ames,	"
23 in. x 8 12 & 14 1-2 ft.	"	Bridgeport,	"
24 in. x 16 ft.	"	New Haven,	good order.
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54 in. x 30 ft.	"	Niles,	good as new.
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15-18-20-23-25-28-34 in. Drills.		30 in. Radial Drill.	
13 in. Stroke Slotter		H. & P.	new.
36 in.	"	Miles, Phila.,	A 1.
Center Bolt Cutter,			new.
5 in. Cutting Off Machine Star.			
Fitchburg Car Axle Lathe.			
Merrill Drops, 800 lbs.			good order.
Bement 2250 lb. Steam Hammer.			

Milling Machines, Screw Machines, Slate Sensitive Drills, Gang Drills, and full line of all kinds of Machine Tools.
Send for list and specify what is wanted.

E. P. BULLARD,
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To Buyers of Engine Lathes

We are now making from entirely new designs, *extra heavy* 19" and 21" Engine Lathes (the most popular sizes), of which we are making a specialty, and manufacturing in lots of not less than 100 at a time.

We make no charge for extras. Every lathe is furnished with *hollow spindle*; the 19" with 1⅝" hole, and 21' with 1⅞" hole. Every lathe has substantial *compound rest*, heavy tool post (bar steel), rest to turn full swing, *following rest* with adjustable jaws to take any size from 2½' down, with extra tool for shafting.

Full set of gears to cut from 2 to 18 threads including 11½ pipe thread. *Automatic stop on carriage. Separate screw and rod feed*, and the most substantial and easily managed *taper attachment* made. Cones and gears of large diameter and wide belt. Studs, screws and small gears are *steel or gun metal*. Webbed live heads, heavy tail stocks. No worm or worm gears, no weak reverse plate. *Perfect lubrication for all running parts*, including carriage.

Lead screw inside of shear, double nut (cut from solid), and taking hold of carriage directly under the line of strain. Friction counter-shaft, the most durable made. Our prices are reasonable for cash, and from which no deviation will be made. Our written guarantee accompanies every lathe.

GUARANTEE.

We guarantee this lathe to be equal in workmanship, truth, accuracy, solidity, material and finish, to the best made, and hold ourselves legally liable for this guarantee.

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Machine Tools,

159, 161, 163 and 165 EGGLESTON AVE.,
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MANUFACTURERS OF IMPROVED CORLISS STEAM ENGINES IN FULL VARIETY.

Sizes Varying From

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Horizontal or Vertical, Direct Acting or Beam, Condensing, Non-Condensing or Compound.

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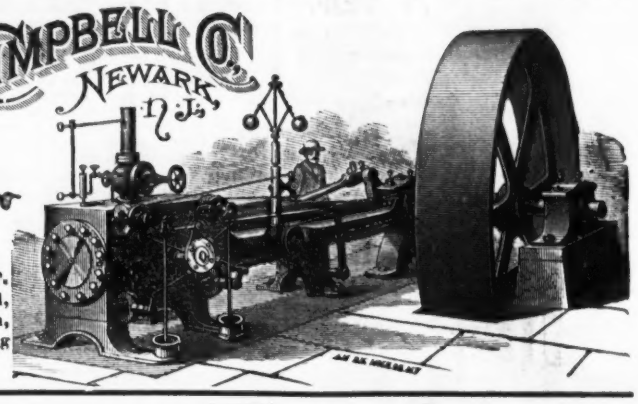

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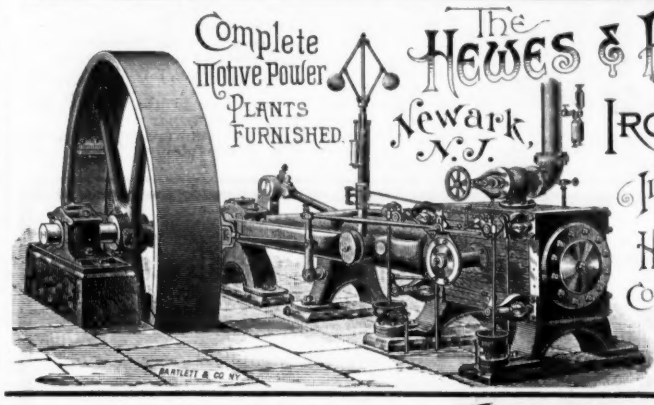
Complete Motive Power Plants Furnished.



Improved CORLISS ENGINES, High Pressure, Condensing and Compound

TUBULAR BOILERS.

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THE IMPROVED FISHKILL CORLISS ENGINE

BUILT BY THE FISHKILL LANDING MACHINE CO.,

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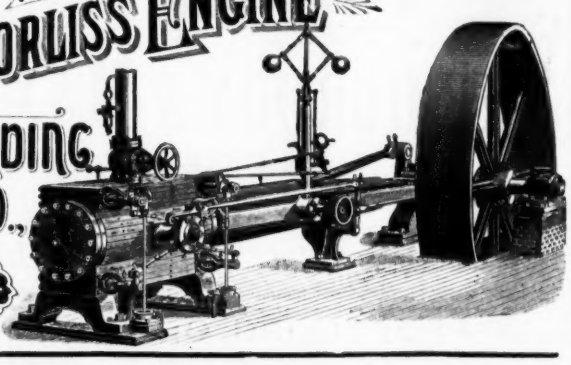

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IRON AND BRASS CASTINGS.

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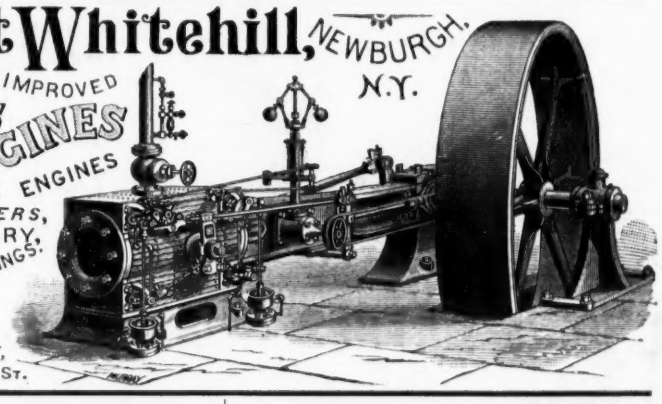
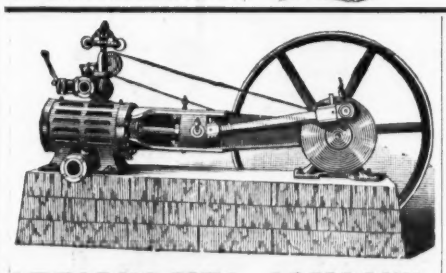
COAL AND IRON EXCHANGE,
COR. CORTLANDT & CHURCH ST.





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Engines from 15 to 400 Horse Power.

Boilers of Steel and Iron supplied to the trade or the user. Send for Catalogues.

SAW MILLS and GENERAL MACHINERY.

Works at ERIE, PA.

Having enlarged our Foundry and otherwise added to our facilities, we are prepared to execute orders for castings weighing from a few pounds to *forty tons*. Our Boring and Turning Mill is one of the largest in the United States, by which we can bore and turn a wheeel or cylinder up to 30 feet in diameter, and we can plane 30 feet long by almost any width. With our *unsurpassed* means for handling heavy work, and shipping *by boat or rail*, we are enabled to

OFFER INDUCEMENTS

to customers.

We make a specialty of machinery for making Sugar, and furnish everything necessary to fully equip Sugar Refineries or Plantations. Satisfaction guaranteed, and patronage solicited.

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"Glenwood Station," Yonkers, N. Y.

JOHN McLAREN,

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BUILDER OF

CORLISS ENGINES,

AIR COMPRESSORS AND BOILERS.

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MACHINERY ON HAND.

13 in. swing,	6 ft. bed, Engine Lathe,	Lathe & Morse.
14 in. swing,	6 ft. bed, "	Blaisdell.
15 in. swing,	8 ft. bed, "	Lathe & Morse.
1 in. swing,	8 ft. bed, "	Blaisdell.
17 in. swing,	8 ft. & 10 ft. bed, "	Lathe & Morse.
18 in. swing,	8 ft. bed, "	Flather.
18 in. swing,	10 ft. bed, "	Flather.
19 in. swing,	7 ft. & 10 ft. bed "	Lathe & Morse.
20 in. swing,	10 ft. bed, "	Flather.
21 in. swing,	14 ft. bed, "	Lathe & Morse.
24 in. swing,	12 ft. bed, "	Fifield.
24 in. swing,	14 ft. bed, "	Blaisdell.
26 in. swing,	20 ft. bed, "	Lathe & Morse.
26 in. swing,	21 ft bed, "	Flather.
27 in. swing,	16 ft. bed, "	Lathe & Morse.
30 in. swing,	16 ft. bed, "	Fifield.
36 in. swing,	18 ft. bed, "	Putnam.
52 in. swing,	15 ft. bed. "	Gleason.
16 in. x 16 in. x 3 ft.	Planer,	Lathe & Morse.
17 in. x 17 in. x 4 ft.	"	Hendey.
20 in. x 20 in. x 4 ft.	"	Lathe & Morse.
22 in. x 22 in. x 5 ft.	"	Hendey.
26 in. x 26 in. x 6 ft.	"	Flather.
26 in. x 26 in. x 8 ft.	"	Flather.
27 in. x 27 in. x 7 ft.	"	Whitcomb.
36 in. x 36 in. x 10 ft.	"	Whitcomb.
15 in. stroke	Shaper	Hendey.
24 in. stroke	"	Hendey.
20 in. stroke	"	Eberhardt.

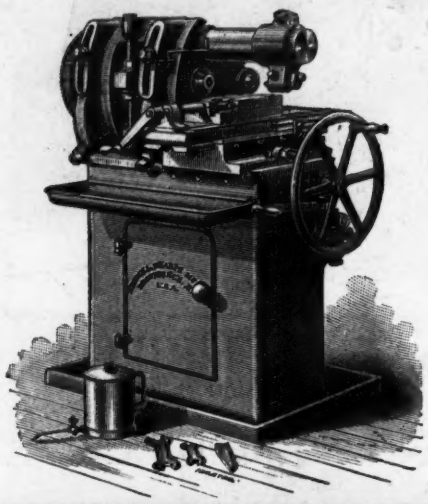
5 ft. Arm Radial Drill, U. R. D. Co.
1 1-2 in. National Bolt Cutter.
1 1-2 in. Acme Bolt Cutter.
Steam Hammer, cylinder 7 1-2 x 17; will forge an average of 4 in. diameter.

33 OLIVER ST., BOSTON

BROWN & SHARPE MFG. CO.,

Manufacturers of MACHINERY & TOOLS, PROVIDENCE, R. I.

Description of No. 3 Plain Milling Machine.



We have in our works and in constant use, about one hundred Milling Machines, and our experience with them has demonstrated that for manufacturing purposes where many duplicate pieces are required, that the best work is produced and the most economical results obtained from machines that are compact and solid, so arranged that the pieces operated upon can be quickly placed in position and quickly removed after the cut is taken.

We have designed a line of Milling Machines for manufacturing purposes, combining the above desirable qualities, of which the No. 3 Plain Milling Machine is a type, and by their use we have found it practicable to produce from 10 to 20 per cent. more work in a given time than we could possibly obtain from any other type of a milling machine on the same work.

The Spindle is driven by a gear and pinion from a three-step cone with 3″ belt. It has a vertical adjustment of 6″.

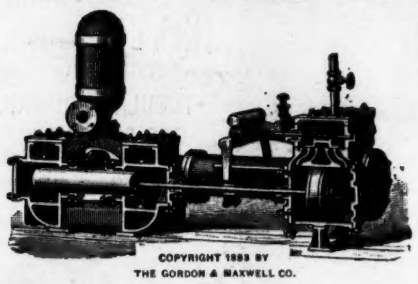
The Table is 9″ wide, 27″ long, and has 12″ longitudinal and 4¼″ transverse movement, and is moved longitudinally 2″ by one turn of the hand-wheel.

The Feed is automatic with three changes, stopping automatically at any required point.

The Vise has jaws 6⅛″ long, 1 7-16″ deep, and will open 3⅝″.

Counter-shaft has pulleys 10″ diam. for 3″ belt, and should run about 375 turns per minute.

The Price includes vise, counter-shaft, wrenches, &c., delivered f. o. b. at Providence, R. I. Weight, 2550 lbs



Duplex Steam Pumps

—AND—

WATER WORKS MACHINERY.

THE GORDON & MAXWELL CO.

HAMILTON, OHIO.

BRANCH HOUSES:

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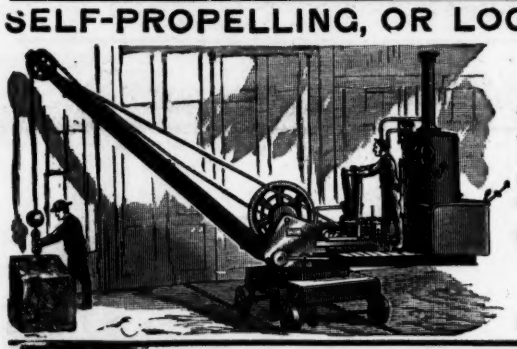
SELF-PROPELLING, OR LOCOMOTIVE CRANES.



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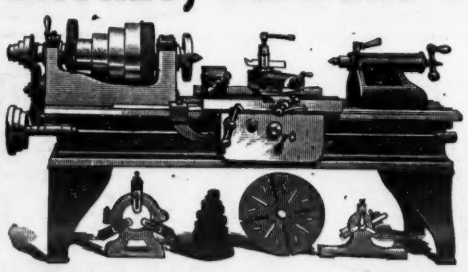

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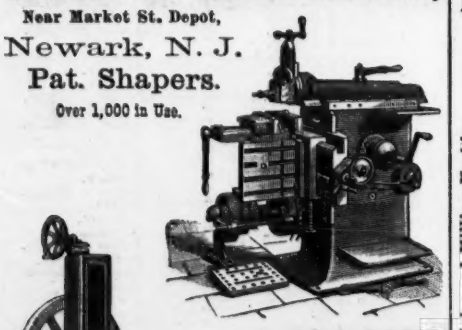

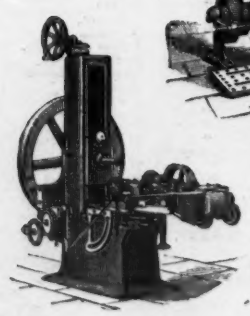

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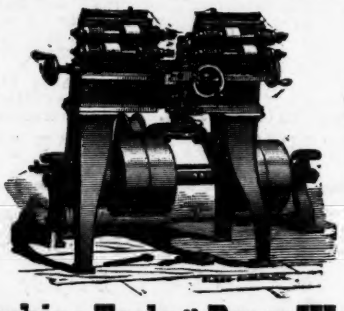

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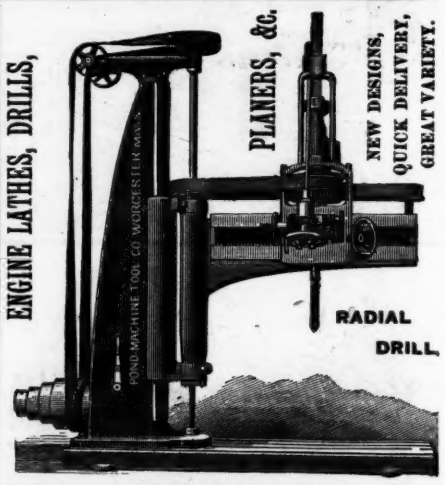

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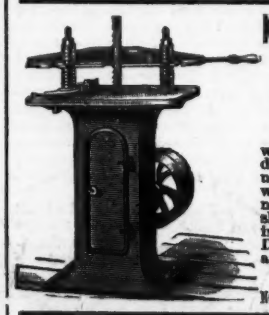

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